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CONTENTS

ELECTRIC RAILWAY TRACTION

A Supplement illustrating and describing developments in Electric Railway Traction is presented with each copy of this week's issue.

Railway Speed Prospects for 1935

THE year just closed has been one of exceptional progress in the matter of railway speed. Under the pressure of unceasing and increasing competition, especially from the air, railways are leaving no stone unturned to prepare their main lines for higher speeds, both of passenger and freight service, than have ever previously operated. Possibilities of steam traction, hitherto unexploited, have been revealed during 1934 in such runs as that of the L.N.E.R. locomotive *Flying Scotsman* on November 30, in maintaining an average speed of 80 m.p.h. for 250 miles of one round journey, or in that of the Chicago, Milwaukee, St. Paul & Pacific 4-6-4 which, in July last, hauled a train for 69 miles at an average of 90 m.p.h. Higher speeds still with steam are being sought with the aid of streamlining, both in America and Germany, and with the improved methods of steam flow from boiler to atmosphere first perfected by the Paris-Orleans Railway of France. The new weapon of diesel propulsion has rendered possible a speed of special inter-city transport that lies even beyond the power of the present steam locomotive to achieve, and which appears likely to extend during 1935 on a scale hitherto unprecedented, as is witnessed by the delivery of further streamlined units to railways in France, Germany, Denmark, and Italy. In America, again, remarkable records have been achieved by diesel-driven units during 1934, such as the 57-hr. run of the Union Pacific six-car train from Los Angeles to New York, or the 1,015-mile non-stop run from Omaha to Chicago of the Burlington Zephyr, with 80 m.p.h. averages for 500 miles and more. The fruits of such enterprise will certainly be seen in 1935.

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Road and Rail Transport

That an attempt would be made sooner than most people imagined to bring about nationalisation of transport was a prophecy indulged in by Mr. Ernest Bevin at Manchester recently in moving the adoption of a report on the new national agreement affecting wages, hours, and conditions in the goods section of the road transport industry. By way of backing up his opinion that from the public point of view it did not matter whether goods were carried by road or rail and so would ultimately have to go into one pool, Mr. Bevin said the same conditions should apply to the transport industry as applied to the postal services. The telegraph would have gone because the telephone would have wiped it out, but revenue from the new invention had gone to sustain the older, enabling the Post Office to keep up to date and maintain all its services. The need for definite agreements regarding wages and hours in the road transport industry was emphasised by Mr. Bevin's statement that the conditions were as bad as any he had found anywhere since he began to investigate sweating conditions. He had found that the agreements regarding wages which were presumed to exist did not apply effectively to more than about 5 per cent. of the people concerned.

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The Week's Traffics

The latest traffic returns of the four amalgamated companies cover the week ended January 6 in three cases and therefore include one day of the old year. The L.N.E.R. return for the week ended January 5 includes two days of 1934. As shown by the accompanying table there is considerable variation, the best showing both actually and proportionately being that of the London & North Eastern. For the corresponding week a year ago none of the companies had an increase in passenger train traffic except the London & North Eastern, but all had increases under goods and coal, the L.M.S. then having gains of £38,000 and £27,000 respectively. Although the reduced first class monthly fares have only been in operation since January 1 there has already been a slight increase in the number of first class passengers with a considerably larger number of inquiries.

	1st Week				
	Pass., &c.	Goods, &c.	Coal, &c.	Total.	Inc. or dec.
	£	£	£	£	%
L.M.S.R.	+ 22,000	− 12,000	− 19,000	− 9,000	− 0·93
L.N.E.R.	+ 20,000	+ 20,000	− 2,000	+ 38,000	+ 5·41
G.W.R.	+ 4,000	+ 1,000	− 11,000	− 6,000	− 1·40
S.R.	+ 9,000	+ 1,000	+ 1,000	+ 11,000	+ 3·61

London Transport returns for the 27 weeks of the current financial year show an increase of £308,100.

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The L.N.E.R. 1935 Programme

Following the announcements of the G.W.R. and L.M.S.R. renewal programmes, recorded in our issue of last week, that of the L.N.E.R. for the next twelve months has now been issued. As set out on a later page of this issue, and further referred to in the Contracts and Tenders section, it will be seen that provision has been made for 88 new locomotives, of which 14, of a design not yet

finally decided upon, are specially intended for heavy, long-distance work. The wagon programme covers approximately 5,000 goods vehicles, as compared with 5,579 for last year. Of these, 3,780 12-ton vehicles will be vacuum-fitted, and a notable feature is the inclusion of 100 all-welded steel 20-ton wagons. The 315 new coaches include one tourist train set and spares, which as already announced in the Contracts and Tenders page in our December 21, 1934, issue, are on order from outside firms. The completion of these will bring the total of special tourist train sets in L.N.E.R. service to nine. Four new eight-coach train-sets are to be built for the Great Eastern suburban service. Permanent way will be renewed over an aggregate mileage of 436 and 37 bridges will be reconstructed. Other work includes the adoption of special colour schemes for certain important stations. As in the case of the L.M.S.R., the L.N.E.R. will purchase a proportion of its new locomotives and rolling-stock during the year, and in common with the L.M.S., G.W. and Southern Railways, will also require a good deal of new material, spare and other parts from the trade during the year.

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Australian Commonwealth Railways

Earnings of the Australian Commonwealth Railways for the year ended June 30, 1934, were on the whole £21,503 higher than for the previous year, as each system showed an increase except the Central Australia. Working expenses, however, advanced to the extent of £28,367, and the loss on working as a whole was £6,864 higher. On the North Australia Railway, which is an isolated system, the loss was £11,786, or £4,624 less than in the previous year, and on the Federal Territory Railway the earnings exceeded working expenses by £358. Increased sleeper renewals involving an additional expenditure of over £20,700 accounted for the greater loss on the Trans-Australian Railway, and the increased loss on the Central Australia Railway was due to expenditure caused by flood damage and to more sleeper renewals.

	Earnings		Working Expenses	
	1933–34	1932–33	1933–34	1932–33
	£	£	£	£
Trans-Australian Railway.. (Port Augusta-Kalgoorlie, 1,051 miles 68 ch. 4-ft. 8½-in. gauge)	206,205	188,168	218,506	197,363
Central Australia Railway.. (Port Augusta-Alice Springs, 771 miles 33 ch. 3-ft. 6-in. gauge)	90,566	93,359	113,050	106,875
North Australia Railway .. (Darwin-Birdum, 316 miles 40 ch. 3-ft. 6-in. gauge)	27,907	22,612	39,693	38,843
Federal Territory Railway (Queanbeyan-Canberra, 4 miles 75 ch. 4-ft. 8½-in. gauge)	5,277	4,313	4,919	4,720
Total, 2,144 miles 56 ch...	329,955	308,452	376,168	347,801

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Tasmanian Government Railways

A gratifying feature of the working of the Government Railways of Tasmania for the financial year ended June 30, 1934, has been the increase of £9,420 in revenue, comparing with an increase of £200 in 1932-33, which was the first for many years. Expenditure, however, advanced by £11,621, due largely to wages awards by the Federal Arbitration Court, to necessary repairs to the Leith bridge and to the restoration of bridges on the West Coast destroyed by fire. In the report by Mr. F. P. St. Hill, Commissioner for Railways, it is mentioned that the Sentinel-Cammell car fulfils all requirements excellently, and the two new cars recently imported for the Hobart-Launceston passenger service have shown in their trial runs that they have sufficient reserve power to meet all the demands likely to be made upon them.

	1933–34	1932–33
Passengers..	1,789,329	1,678,483
Goods and minerals, tons	539,847	489,776
Train-miles	1,137,477	1,111,724
Operating ratio, per cent.	98·59	97·97
	£	£
Passenger receipts ..	107,097	104,978
Goods and minerals receipts	230,596	223,262
Total earnings	390,903	381,483
Working expenses ..	385,383	373,762
Surplus on working ..	5,520	7,721

New rate books providing for very substantial reductions in both fares and freights have been issued.

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Jamaica Government Railway

Bananas provide the chief part of the goods traffic revenue of the Jamaica Government Railway, which has 210 miles of standard gauge line in operation. During the financial year ended March 31, 1934, the report on which has been forwarded to us by Mr. H. R. Fox, the Acting Director, the banana industry—already severely hit by a destructive storm in November, 1932—suffered severely from flood rains which were almost continuous from June to the end of November, 1933, and from a storm over the south-western portion of the island in October. In gross revenue the decrease of £97,237 was a result not only of abnormal weather conditions, but also of trade depression and road motor competition. Making good the flood damage cost approximately £59,000 and was the sole cause of the net increase of £20,213 in expenditure. Although the track received during the year under review damage which it had probably never received previously, it was restored to normal conditions by the end of January, 1934.

	1933–34	1932–33
Passengers	493,980	587,890
Goods traffic, tons	207,358	298,469
Operating ratio, per cent.	115·2	73·9
	£	£
Coaching receipts	40,297	47,844
Goods traffic receipts	163,820	245,212
Gross receipts	224,987	322,224
Working expenditure	265,083	244,870
Working profit (+) or loss (−) ..	− 40,096	+ 77,354

Total debt charges on the railway during the year under review amounted to £156,924, making a gross deficit of £197,020 to be met out of the general revenue of the Colony.

* * * *

After 25 Years

Rip van Winkle provides the classic example in fiction of a man's impressions on returning to his native place, but the subject has been made the basis of many stories. In the past fiction has always required the lapse of about a century in order to provide striking contrasts between "then and now," and it is an implicit tribute to the speed of progress on British railways that Mr. C. B. Byles, in his article on pages 47 and 48 herein, can record so much change in a quarter of that period. A former Signal Engineer of the old Lancashire & Yorkshire Railway, he left England for Australia about a quarter of a century ago, and has now for the first time re-visited the home land. Modern publicity and salesmanship contrasts sharply to his mind with the "dignity of railroading" in earlier years, and, although these are a necessary concomitant of the modern struggle to sell, it is pleasant to record his impression that the uniform courtesy and helpfulness of the staff remains unimpaired. Dealing with his

particular subject of signalling, Mr. Byles makes a plea for uniformity, especially with colour-light aspects, but apart from this criticism (which is already appreciated and now under consideration) he has nothing but well deserved tribute to pay to most recent developments.

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Signalling Development: Its Reason and Trend

During the past five years or so, Mr. A. E. Tattersall has read several papers before various societies under the heading of "The Trend of Development in Railway Signalling," but each has been entirely distinct, and this in itself is indicative of the rapid evolution which is taking place to-day in signalling theory and practice. As he pointed out to the York Lecture and Debating Society last night (in a paper to which we refer further on page 62), the expense of any radical signalling change would not generally be justified on safety grounds, for it is impossible to secure absolute safety and the ordinary mechanical signalling system, supplemented by the telegraph block, affords relative security. If, however, modern methods can make a signalman's or driver's task less onerous, then such are worthy of every consideration, even though the material advantages cannot definitely be determined. The outstanding advantage of modern signalling methods is that by providing for automatic operation, not only are operating expenses reduced, but the line, and therefore earning, capacity is increased because it is possible to equalise signal sections, thus keeping trains moving and utilising the capacity of the line to its greatest extent.

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Motor Trolleys and Runaway Catch Points

In the accident reports for the three months ended March 31 last there is one by Mr. J. L. M. Moore on a motor rail trolley, which, when ascending a rising gradient of 1 in 108, was derailed at some runaway catch points owing to being driven through them at an excessive speed. Both of the men who were on the trolley were thrown off; one was killed instantly and the other received serious head injuries. The trolley was in good working order and had trailed through the same points satisfactorily with a similar load on many previous occasions and its failure to do so in this instance can, in Mr. Moore's opinion, be attributed only to excessive speed. Whilst it is true that there is always the risk of any trolley, when lightly loaded, failing to force over the blades of self-acting points and so becoming derailed, there is an additional element of danger with power-driven trolleys, owing to the speed at which they may be travelling. The report concludes thus: "In view of this danger, the trailing of power-driven trolleys through such points is undesirable and the issuing of an instruction against the practice is recommended for the consideration of the company." We suggest that, instead of this total prohibition, it be made a requirement that before the trolley trails through the points it should stop and the points be closed by the emergency hand-lever provided at spring-controlled runaway catch points for use when trains have to pass over them in a facing direction during single line working.

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Colour Control Systems

Those who attended the reading of Mr. G. L. Murray's paper on "Colour Control of Limit Gauging" at the meeting in London of the Institution of Locomotive Engineers heard and saw much of a thought-provoking nature. The paper itself was abstracted in our issue of last week, but those present at its reading saw on the screen through the medium of a epidiascope actual examples of coloured gauges for valve gear maintenance made under the author's supervision while in the Sudan Government Railways and which had already seen some years of regular service. A warm tribute to the value of this colour system as introduced by the author in Sudan was paid by Mr. F. S. Hunkin, formerly Deputy General Manager and Auditor, Sudan Government Railways, who testified to the economies secured in a country where most of the native workers were illiterate. A speaker in the discussion raised the question of colour blindness. The author pointed out that the operator was asked to pair colours, not to name them, and they had met with no difficulty. The system lends itself to the simplification of many processes. Colours can be identified about three times faster than figures and indeed may be said to be a universal language. That the scheme was not entirely new, Mr. Murray demonstrated by showing a volume published in 1847 in which the first six books of Euclid were set out by the use of colours for areas instead of symbols.

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Locomotive Smoke Abatement

In its issue of December, 1934, our American contemporary, the *Railway Mechanical Engineer,* discussed two matters of considerable importance to railway locomotive departments. The first concerned starting locomotive fires in running sheds and particularly referred to the emission of smoke. Contrary to a general belief, it is possible to build such fires to emit very little smoke, as attention to the problem has demonstrated. The trouble is that too frequently little or no thought is given to the elimination of smoke when starting the fires. Reference is made by our contemporary to a paper recently presented at a meeting of the Smoke Prevention Association, in which it was stressed that the operation must not be hurried, and a method of minimising the smoke nuisance was recommended. This was to place sufficient coal in the firebox not merely to start the fire but to take the engine out of the shed, arranging it in the grate to leave a central trough for a quantity of *dry* wood. The use of oily waste, torches, or oil-soaked shavings is bound to make smoke, but the dry wood both reduces smoke emission and enables one man to look after three or four fires. The process may be a little slower, and even in some circumstances rather more expensive, but it certainly removes a serious source of irritation to people living in the vicinity.

* * * *

Machine Tool Repair Economics

Another matter dealt with by our contemporary in the same issue was the repair of machine tools in railway shops, and it was suggested that the cumulative burden of repair expenditure was sometimes underestimated by those responsible for the maintenance of equipment. Studies made during the past few years indicate that what is true of many other types of mechanism is also true of machine tools, namely, that the cost of maintaining them in service increases collaterally with their age. So far as the railways are concerned, sufficient data have not been kept over a period of years to permit the reduction of this factor of machine tool economics to exact figures, but enough is known from the experience of other industries to suggest that railway shops are paying rather a heavy toll on the upkeep of obsolete shop equipment. Figures indicate that the railways spend from three to six times as much, on the investment percentage basis, as they should, probably for no other reason than that the average age of the machine tools is greater than in most modern industrial plants. Modern tools and equipment offer not only the economies of greater productive capacity but a considerable saving in maintenance costs as well.

Preparing the Track for High Speed Trains

BEFORE it is possible to institute regular operating speeds like those of the Flying Hamburger and other special high speed railway units, it is, of course, necessary to make sure that the permanent way is in a condition to ensure not only safety but also the comfort of passengers. An account of the steps taken to prepare the track of the Chicago, Burlington & Quincy line between Chicago and St. Paul, a distance of 431 miles, for the regular 6½ hour service to be put into operation early this year by means of the Zephyr-type streamlined diesel-electric trains, is contained in a recent issue of our American contemporary the *Railway Age* The end to end speed works out at 66·3 m.p.h. but it will be necessary for the trains to maintain an average of about 85 m.p.h. outside the yards and except where certain speed restrictions are in force. The track adjustments which have been carried out include two minor line revisions and the realignment of one curve to obviate a speed restriction. Included among the refinements are modifications of cant, the insertion of transitions to all curves of one degree (5,730 ft.) or sharper, the lengthening of existing transitions on curves of two degrees (2,865 ft.) and over, and careful adjustment of the run-off at the ends of curves. At several points also the track is being realigned through junctions. The line is easily graded throughout and is laid with 100, 110 and 112 lb. rail, except for a few stretches of 90 lb. rail, on treated sleepers and gravel ballast.

When it was decided to place the new trains in service on this line test runs were made with the original Burlington Zephyr. First of all the cant of every curve was recorded on a condensed alignment map and the allowable speed was calculated and marked on it. The only actual work carried out prior to the tests was to remove any irregularities of cant. From the alignment map or chart a timetable was prepared based on the power output of the engine. In the meantime a new table of curve superelevations was in preparation. The ordinary cant tables were based on speeds lower than those required by the new schedules, but they also allowed for much higher centres of gravity for locomotives and rolling stock than the 53½ in. height of that of the leading car of the new high speed trains. It is evident therefore that the overturning moment for a given speed is considerably less in the new trains than in those at present in operation, and the cant on a given curve may safely be less for the former. Five inches was selected as the maximum permissible cant to avoid handicapping slow traffic, particularly freight trains, and restrictions are being placed on all curves where it is necessary to bring the speed within the limits allowable for this cant.

Very careful observations of speed and riding qualities were taken during the trial runs from various parts of the trains, and a Sperry track recorder was used as a check. The notes of the several observers when compared were found to be in substantial agreement and in every case their recommendations for alterations to the track were confirmed by the Sperry record. Further tests indicated that for maximum comfort at the higher speeds the easiest approach to a curve can be made when the rise is at the rate of not less than 1¼ in. per sec. at 85 m.p.h. This requires a run-off of 1 in. in 100 ft. At 100 m.p.h. it will be 1⅛ in. As the rate had to be fixed, that for 85 m.p.h. was selected as the most suitable for all speeds except on restricted curves where the same rate of 1¼ in. rise per sec. was applied for the lower speeds. The acceleration from standstill to 60 m.p.h. is very good, but above that speed it drops progressively; it is therefore important to eliminate as far as possible restrictions that interfere with sustained high speed. It was found that surprisingly few changes were required in the track to permit of the operation of these high speed trains.

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South African Railways and Harbours

IMPROVED conditions in the Union of South Africa are reflected in the report on the working of the railways and harbours of the Union for the financial year ended March 31, 1934, which we have received from Mr. T. H. Watermeyer, the General Manager. Following the practice of previous years the report gives an interesting review of the general state of affairs in the Dominion. The year under review marked the turn of the tide in the downward tendency of prices, and the steady revival from the depressed conditions of railway revenue which had prevailed during the previous three years. It punctuates, too, active progress in many directions in the constructive policy of the administration of the Railways and Harbours Department. As a consequence of the improved commercial and industrial conditions, the final result of the year's working of all services—railways (main and subsidiary services), harbours, steamships, and airways—was a surplus of £1,523,807, against a deficit of £1,193,868 for the previous year, after making allowance for all outgoings. Some figures relating to railway transportation services are compared in the accompanying table. The final surplus is arrived at after allowing for receipts and outgoings in respect of subsidiary services, *i.e.*, road motors, catering and bedding, bookstalls and advertising, and for interest charges. There was a reduction in interest charges from £5,741,581 to £5,337,838. This is due to the fact that in terms of Act No. 64 of 1934, and as from April 1, 1933, the Treasury waived interest charges at the rate of 3½ per cent. per annum on £13,138,264 representing the expenditure on capital works financed from revenue funds prior to Union.

	1933-34	1932-33
Passenger journeys	75,757,764	69,921,653
Goods and minerals, tons	13,195,413	11,476,544
Coal traffic, tons	7,228,082	6,545,500
Ton-miles (revenue earning)	4,142,917,964	3,759,085,452
Average haul, miles	198	205
Route miles open	12,296	12,267
Train-miles	43,653,289	39,576,745
Operating ratio, per cent.	71·37	75·61
	£	£
Capital expenditure (open lines)	148,758,522	148,101,387
Passenger receipts	4,532,651	4,107,169
Goods and mineral receipts (other than coal)	13,985,115	11,887,298
Coal traffic receipts	2,965,476	2,661,667
Total receipts	23,707,524	20,619,878
Gross working expenditure (including depreciation)	16,919,521	15,591,054
Surplus over expenditure	6,788,003	5,028,824
Final surplus	Cr. 1,813,505	Dr. 627,120

On harbours there was a surplus of £46,823, and on steamships one of £4,007, but on airways there was a deficit of £3,528. The contribution to betterment fund was £50,000, and to reduction of deficiency in pension and superannuation funds £287,000. The report points out that the improved results of working were brought about entirely by increased earnings and not by further reductions in expenditure. In fact payments for salaries, wages and travelling expenses of the railway and harbour staff increased from £11,552,840 to £12,426,522, an advance of £873,682 or 7·56 per cent. due mainly to the removal of the temporary cuts made during the period of depression. It is noted that the rise in earnings during the past

eighteen months was caused by three principal factors, first, the extensive mining development on the Witwatersrand due to the high price of gold; secondly the replenishment of supplies on a large scale by storekeepers and merchants who had allowed their stocks to dwindle to a minimum, and thirdly the heavy importations of new motorcars. Goods and mineral traffic (other than coal) showed a general increase except in agricultural products. Higher rated commodities (Tariffs 1—6) advanced by 468,534 tons or 17·53 per cent. Tonnage of revenue earning goods traffic increased by 14·98 per cent. but ton-mileage by only 5·33 per cent. A shortfall in maize and maize products conveyed over long distances for export, and an increase in short-distance general traffic explains the discrepancy. Total earnings increased by £3,087,646 or 14·97 per cent. Discontinuance of "cuts" was responsible for more than half of the increase of £1,328,467 or 8·52 per cent. in gross working expenditure. Expenditure on maintenance of permanent way and works cost £164,852, or 7·61 per cent., more. Track renewals, the provision of enlarged fishplates to assist in the elimination of dipped joints, and strengthening of permanent way and bridges, contributed to this increase. Additional train and engine mileage accounted for a large part of the increase of £420,688 or a rise of 10·83 per cent. in running expenses.

Reference is made to the report of the Granet Commission, which generally speaking reveals the position of the Union railways and harbours in a comparatively favourable light particularly from the standpoints of finance and control. The General Manager considers that the time is now opportune for the appointment of a committee of research consisting of senior railway officers to investigate ways and means of reducing ton-mile costs. Amongst the more important aspects of railway operation to be investigated by the committee will be engine power, rolling stock (including the future possibilities of diesel railcars), track improvements, train services, the more intensive use of rolling stock, marshalling yard and terminal facilities, &c. Road motor services brought in £73,829 more revenue, and a net surplus of £33,095 against £4,768 in the previous year. On the subject of road competition the report states that competition from taxi operators in country districts continues unabated, and that animal-drawn transport is developing into a highly competitive means of conveyance for high-rated goods traffic. In some cases animal-drawn wagons operating from coastal towns connect up *en route* with road motor services, thereby affording many distant inland concerns road transport for the conveyance of their requirements at most uneconomical charges. This competition is often accompanied by gross cruelty to the animals employed in it. The General Manager advocates the establishment of a Ministry of Transport responsible for the control of the South African Railways and Harbours and the regulation of all road transport and air services within the Union as well as sea transport serving Union ports. The route mileage of electrified lines at March 31, 1934, excluding the Cape Flats line which was not opened for commercial operation until April 23, 1934, was 232 miles 29 chains including Glencoe-Cato Ridge 200 miles 17 chains, Capetown-Simonstown (suburban) 22 miles 42 chains, and Salt River-Belleville (main line) 9 miles 50 chains. Work is in hand on the Cato Ridge-Durban electrification scheme, and it has been decided to electrify from Glencoe northwards to Volksrust. Work on the electrification of the Diamana-Harrismith section of the line from Natal to the Orange Free State was in hand when the Granet Commission arrived in the Union. A yearly saving of £26,500 is expected from it.

The Winwick Junction Accident Report

THE report by Colonel Trench on the collision of September 28 at Winwick Junction, Warrington, L.M.S.R., was issued on January 3 and is summarised on a later page. Although there were 11 fatal casualties the cause of the accident was so simple that its consideration calls for few remarks. The local train, with which the express from Euston to Blackpool collided, would probably not have been overlooked but for two small coincidences. The signalman, after the entrance of the local train into his section, was concerned over the sequence to be taken by some up trains, which led, among other things, to telephonic communications with neighbouring boxes. The local train meantime arrived and came to a stand at the home signals, 172 yd. from the box, but the signalman failed to see it—the hour was 9 p.m.—and forgot its presence. He had the help of a train-register boy, but—the other unfortunate coincidence—after that youth had recorded the acceptance of the local train he had to leave the train-booking in order to record, at the other end of the box, the intended running of some special trains and so the register did not record the entrance into the section of the local train. The block instrument concerned was duly recording *train on line* for the local, but, when the box in the rear gave the "attention" signal, preparatory to the shunt-train-for-following-train-to-pass block signal, the signalman at Winwick Junction, forgetful of the local train, thought that he had failed to clear an earlier train that had passed at 8.56. He thereupon irregularly gave out-of-section and accepted the express, and the collision followed. The train-register boy, hearing the express accepted, assumed that the local had passed whilst he was otherwise engaged, and he made entries in his book that approximated with what they would have been had the local not been detained. On that point Colonel Trench has some interesting suggestions to make.

It is obvious that track circuit in the rear of the home signals would have prevented the acceptance of the express. In that relation we would observe that a personal inspection of the place—which is quite in open country—confirms us in the opinion of the L.M.S. officers that Winwick Junction was, as to the need for track circuit, "low in the order of urgency, in view of the proximity of the home signal to the box, the reasonably good view, and the fact that it was seldom necessary to hold trains at that signal." We concur, too, in the opinion expressed by Colonel Trench that "In the last few years the company has made very rapid progress with the provision of track circuit generally." On that point reference to the L.M.S. annual reports shows that that company, during the four years, 1930-1933, spent £357,062 on track circuits, telephones and telegraphs, and proposed to expend a further £80,000 in 1934 and subsequently.

The report, finally, is of interest in that, in answer to the charges in certain sections of the daily press, it shows that the companies generally have adopted a certain policy as to all-steel coaches; that this was reviewed but not changed, after the Lagny disaster of a year ago; and that "the Inspecting Officers have considered the question on several occasions during the last few years and are in agreement with the opinion expressed by the companies, always provided that progress is maintained in conversion to electric lighting, and that frames, buffers, couplings, vestibules, &c., are so constructed as to reduce the liability to telescoping. The results of an accident at high speed are largely fortuitous and it seems preferable to devote available resources to measures for the prevention of accidents rather than to minimising their results."

LETTERS TO THE EDITOR

(The Editor is not responsible for the opinions of correspondents)

Overseas Number of "The Railway Gazette"

Sudan Railways,
Atbara, Sudan.
December 28

TO THE EDITOR OF THE RAILWAY GAZETTE

SIR,—May I congratulate you on a most interesting issue full of instructive information for the overseas railwayman, whose problems are so totally different to those of the man in Europe, that though he may follow European developments with interest, he knows that very little of what he reads is of much practical help in solving the difficulties he himself has to meet.

Your "Overseas Railways Number" of November 28, 1934, however, gives just that short review of the circumstances in which a large number of overseas railways find themselves, which enables the reader to spot where conditions approximate to his own circumstances and to note how they are being tackled.

Yours faithfully,
C. J. H. HUNTER,
Deputy General Manager.

The New Year

Railway Coal Depot,
Starbeck, Harrogate.
January 7

TO THE EDITOR OF THE RAILWAY GAZETTE

SIR,—This is just to say how much I like your opening editorial in your January 4 issue. It is, I think, the most cheerful (and sensible) of all the railway new year messages.

Yours faithfully,
E. M. BYWELL

European Speed Comparisons

Somerset Hotel, Orchard Street, W.1.
December 30

TO THE EDITOR OF THE RAILWAY GAZETTE

SIR,—In the article on pages 1034-7 of your issue of December 21 I noticed one slight error which, in view of the great value of such an article as an historical record, I think should be corrected. On page 1035 (G.W.R. London-Birmingham service) it is stated that the mid-day two-hour train from Paddington did not reappear after the war. It *did*, but was withdrawn in May, 1924 (it left Paddington at 12.50), at which date the 1.15 from Euston was also taken off—a very striking confirmation of the last sentence in your editorial on pages 1012-13.

It also appears to me that the references (page 1035) to the German "D" and "FD" supplements are a little misleading. The "FD" charge (irrespective of class, but now graded 2 RM up to 300 km. and 3 RM over 300 km.) is really a very small extra fare, and its main object is undoubtedly to keep "FD" trains clear of short-distance traffic (Cologne-Berlin "FD's" have, for example, some 5 stops between Cologne and Hamm, and would be flooded out without this restriction), while the "E" and "D" charges are really the supplements required for fast travel over and above the basic fare, which applies only to slow trains. But these supplements are very low (compared, for instance, with our Queen of Scots Pullman supplements)—for "E" trains 50 Pf. (2nd) and 25 Pf. (3rd) for each 75 km. up to 300 km., and then 2 RM 50 Pf. 2nd and 1 RM 25 Pf. 3rd for distances above 300 km. "D" charges are exactly double the "E" tariff, and similarly graded by distance—1st or 2nd class being charged the same. "FFD" is, of course, exactly double the "FD" charge (but it really applies only to the Rheingold, which is virtually a *luxe*).

The phrase "seat charge for the use of "D" class express trains" ought, I think, to be given a little further explanation, as the seat reservation charge in Germany is not compulsory on any class of train, and (if incurred by the passenger) is over and above "ED" and "FD" charges.

Yours faithfully,
R. E. CHARLEWOOD

The British Railways Press Office,
35, Parliament Street, S.W.1, December 22

TO THE EDITOR OF THE RAILWAY GAZETTE

SIR,—Your interesting contribution regarding the development of European train speeds makes no mention of the reported statement by Sir Josiah Stamp at Warrington on December 10, who, when he spoke of the accelerations which his company had effected in both passenger and freight services, said:—

> What has been the cost of this acceleration so far? I am glad to say that any mathematical addition that might have been predicted has been to a great extent offset by more economical coal consumption per mile and various operating economies.

It would be interesting to know if this economic aspect of the problem was taken into consideration by your correspondent in his analysis, and whether any figures or facts are available as to the commercial results obtained by higher speeds on European railways.

Yours very truly,
JOHN R. HIND

[It would be extremely difficult to arrive at any exact comparison on the lines suggested by Mr. Hind, owing to the number and variety of the factors involved. In experimental runs, such as those which have been undertaken on an extensive scale during the past autumn by the L.M.S. Railway on the Anglo-Scottish and Euston-Wolverhampton services, the bearing of increased speed on fuel consumption can be gauged, but its effects on maintenance are less easy to arrive at, and no published figures are available on these points. Still more intangible is the publicity value of higher speed, and this can be judged only by its effects. A good example of the commercial value of acceleration is found in such a train as the south-bound Comet, of the L.M.S.R., which since its acceleration to a 3¼-hr. run from Manchester to Euston has grown gradually in weight from its original seven coaches (from Stafford to Euston) to a normal load of ten vehicles, now including two sets of dining cars, and always well filled. This appears to prove that higher speeds do not fail to bring their reward.—ED., *R.G.*]

First Class Fares

Burton-on-Trent, January 2

TO THE EDITOR OF THE RAILWAY GAZETTE

SIR,—The method of calculating the new first class fares for monthly return tickets emphasises the cumulative effect of the "fractions of threepence" which the railway companies extract from passengers in the apparent hope that they are not noticed.

As an example, consider the fares between two stations 20½ to 21 miles apart. The ordinary third class single fare will have been arrived at on the basis of 1½d. per mile for 21 miles, *i.e.*, 2s. 7½d., which will have been rounded off to 2s. 8d. The addition of the halfpenny will have caused an addition of 3d. in arriving at the third class return fare, *i.e.*, 2s. 8d. plus one third, or 3s. 7d. rounded off to 3s. 9d.

The first class fare is in turn calculated at 3s. 9d. plus one half, a total of 5s. 7½d., which is made up to 5s. 9d. The authority of the railways to add the initial halfpenny has thus led to their adding a further sixpence.

Advertisements of first class fares at 1½d. a mile would lead a prospective passenger to assume that for a journey not exceeding 21 miles in each direction the return fare would not exceed 5s. 3d. At 5s. 9d., however, the fare actually works out at practically 1⅔d. a mile.

H. H. THORPE

PUBLICATIONS RECEIVED

Whitaker's Almanack, 1935. Complete Edition. London: 12, Warwick Lane, Paternoster Row, E.C. 7½ in. × 5¼ in. × 1¾ in. Over 1,000 pages. Cloth. Price 6s. net.—The 1935 Whitaker fully maintains its reputation as the indispensable handy guide on a scale unsurpassed by any other publication of the kind. It contains an account of the astronomical and other phenomena and a vast amount of information respecting the government, finances, population, commerce, and general statistics of the various countries of the world. Railways, in which we are particularly interested, are mentioned in 57 entries out of the 26,000 in the index, and are given their fair proportion of space in a work of so general a character. The statistical and other information relating to British railways is set out on the whole with conciseness and accuracy, but some correction is required in the tables of fastest and longest runs on p. 640. For instance, the French Northern and Eastern Railways are neither usually nor correctly described as French State (Nord) and French State (Est), respectively. Recent expert opinion also challenges the accuracy of the statement that "the highest authentic speed ever recorded was on a journey from Plymouth to Paddington on May 9, 1904, 102·3 miles per hour." On a matter of topical interest, it is not correct to say (as on p. 885) that the inhabitants of the Saar are to decide by a plebiscite whether they will *remain* French, return to Germany, or become a self-governing community.

Southern Golf. By E. P. Leigh-Bennett. Illustrated by Helen McKie. London: Southern Railway, Waterloo Station, S.E.1. 8¾ in. × 5¾ in. 167 pp. Price 2s. 6d. net.—That some of the finest stretches of health-giving cliff and hill top, park and grass land in the country are set apart for the enjoyment of golfers is a prevalent and not unjustified impression. Let us hope the golfer appreciates his good fortune. Certainly, a glance through the entertaining pages of this well-informed and aptly illustrated book will induce him to take the first opportunity of pitting his skill against the bogey of one or other of the friendly fairways so attractively described. A few extracts taken more or less at random illustrate the compelling qualities of the book, which cannot fail to attract golfers and non-golfers alike. Thus we read of one course within easy reach of the Metropolis, "A further attribute of this great golf course . . . is the peace and quietness that seem always to overlie the place"; of another, "It is across the calm blue waters of this estuary that the player gazes joyfully as he waits on the first tee . . ."; and again, ". . . at the end of your epoch-making round, linen-coated menservants will produce lunch of supreme quality, and Kentish ale in tankards—than which there could be no more fitting finale to any round in any place." Altogether the Southern Railway affords access to no fewer than two hundred and thirty-two golf courses in England and on the Continent, and particulars of each are given.

Torsional Vibration: Elementary Theory and Design Calculations. By W. A. Tuplin, M.Sc. London: Chapman and Hall, Ltd., 11, Henrietta Street, W.C.2. 8¾ in. × 5½ in. × 1¼ in. 320 pp. Illustrated. Price 21s.—Torsional vibration presents some of the most disagreeable phenomena encountered in engineering, and failures of machinery due to this cause were in former days far from uncommon. These failures were regarded as something of a mystery, for when as a last resort in their investigation calculations were made, it usually appeared quite evident that the broken part possessed an ample margin of strength to resist forces as had been applied. Nowadays it is realised that such highly elastic members as long shafts are liable to suffer the impact of forces hitherto unsuspected, these arising out of the relative motion between masses previously imagined to rotate *en bloc*. Every shaft carrying flanges, discs, wheels or webs constitutes a system susceptible to vibrations of a torsional kind, and undamped torsional vibrations can lead to stress intensities up to the elastic limit of the material. This possibility was overlooked in the designing of early high-speed machinery and in the first of the inquests thereon. To-day vibration receives its due measure of attention, and designers are well aware that they must either make shafts and other components with vibration periods remote from the periods of working impulses, or else incorporate some form of damper.

However, it is one thing to know the end that must be attained and another to attain it. The periodicity of a system cannot be ascertained until the system itself is imagined in detail and even then the amount of calculation involved is formidable. That he should ever be called upon to design the crank-shaft for a multi-cylinder internal combustion engine remains therefore the secret dread of every conscientious designer and the spoiler of all repose. To those who have been haunted in this respect and still more to those on whom the dread task has actually fallen it will come as good news that an extremely able and practical book has now been published dealing with this intricate subject of torsional vibrations.

In this book every conceivable system receives treatment in a general way, and many of the more commonly encountered systems are worked out in detail, figures having been introduced to make illustrative numerical examples. How to set out the calculations and what assumptions can be made for keyed-on members, wheel bosses, shoulders and the like—these and other essentially practical and helpful details are specifically and clearly dealt with. The book constitutes an authority on which any man might lean with confidence, and, considering the vast amount of work it embodies, it is a cheap book. Included among its seventeen chapters is one on the analysis into its simple harmonic components of a periodic but non-harmonic crank torque. The effect of dampers, hydraulic couplings and other special devices is also adequately indicated.

The Welding and Cutting Year Book, 1934-35. Edited by C. Helsby and C. W. Hamann. Reading: The Berkshire Printing Co. Ltd. 8½ in. × 5½ in. 250 pp. Illustrated. Price 6s.—This is the first of what is intended to be a series of annual issues. The first seven of the sixteen chapters are devoted to a useful outline of seven distinct welding processes and the necessary plant. There follow two chapters on welding and cutting, and six more which cover mechanics, testing, metallurgy, procedure control and the training of welders. The sixteenth chapter is an excellent list of 91 engineering journals of all countries, devoted entirely or in part to welding news: a commendable inclusion. We recommend the editors to help their more technical but ill-documented readers by extending the idea in the form of a short bibliography after each chapter, indicating the most recently published papers relating to the text.

The latter half of the book seems to us faulty in conception and approach. The sections concerned with mechanics, testing and metallurgy are discursive and too elementary. They compete with monthly trade publications, which are, on the whole, doing the job better. For instance, while the chapter on the mechanics of welded joints is sound, it is too elementary to assist the draughtsman, who turns to it for a hint, say, of a neat expedient for overcoming difficulties of space restriction or of load transmission. The 26 lines devoted to hardness testing consist essentially of a mere re-statement of the formula for computing Brinell numerals. A table of numerals showing equivalent tensile strengths and compiled for varying sizes of ball would have been useful, as well as some practical hints on how to apply the test. There is room for improvement in the index and the illustrations, and, indeed, we fear that unless a higher standard of knowledge among welding engineers is assumed, and the more technical sections treated constructively as a review of opinion and progress in the application of the subjects treated, this year book will scarcely fulfil the need there is for such an annual work of reference.

THE SCRAP HEAP

WHAT STRUCK ME

The following remarks regarding a night trip on a railway engine won 7s. 6d. for Mr. A. L. Frost, of Takeley, near Bishop's Stortford, for his letter to the *Star*, of London:—

(1) Terrific heat from the firebox. (2) Blinding light when fireman opened fire door to stoke up. (3) Smooth, rhythmic motion of his body in swinging the shovel. (4) Jolting, swaying and discomfort of the ride. (5) Terrific din when we passed by sidings and stations. (6) Deafening blast of the exhaust from the chimney when we climbed a gradient. (7) Thrill of dashing headlong into darkness. (8) Pin points of engine lamps. (9) The way the signal lights twinkled in the darkness. (10) The calm, quiet indifference of the driver and fireman.

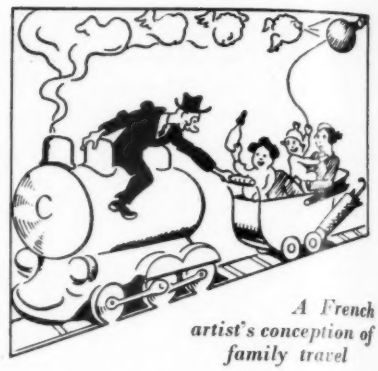
The railway inspector was objecting to the length of the line overseer's reports. "Don't make them so wordy," he protested. "Just put down the condition of the track as you find it. Leave out everything that isn't absolutely to the point. I want a business report, not a novel."

The overseer replied that he grasped the idea. A few days later the line was badly flooded, and the overseer wrote his report to the inspector in the new manner. It read: "Where the railway was the river is."—*From "Tit-Bits."*

* * *

FAMILY TRAVEL IN FRANCE

We reproduce herewith one of the many amusing illustrations from a



A French artist's conception of family travel

guide to travel facilities recently published as a combined venture by the French railways. The general purpose of the booklet, entitled "Guide Pratique du Voyageur," was outlined in an editorial article in our issue of August 17, 1934. In the example herewith the artist has drawn his inspiration from the blessings of the family ticket. This is a concession which offers many conveniences to the father who has to travel with a retinue of offspring in tow, although he may not do so as literally as appears in the drawing.

* * *

The holiday train was crowded. In one coach was a woman accompanied by a little girl and a boy. The children were full of high spirits and gambolled through the coach, much to the annoyance of other passengers. Finally one could stand it no longer.

"Madam," she said, "if you can't keep your children quiet I shall lodge a complaint."

The mother sighed.

"Your misfortunes don't compare with mine," she replied. "My little girl has just swallowed our tickets, the boy has broken a coach window, I've left my purse at home, and we're on the wrong train."—*From "The Santa Fe Magazine."*

* * *

Fifty years ago the *Western Mail* of January 7, 1885, quoted our predecessor *The Railway Times* in saying:—"With reference to the contemplated amalgamation of the Taff Vale Railway and the Bute Docks, it is stated that the Bute Trustees, as landowners, are to receive royalties similar to those payable by the railway company to Lord Windsor in connection with the Penarth Dock, and the Marquis of Bute is to receive, in respect of the capital expended upon the dock undertaking, £750,000 four per cent. preference stock and £862,500 ordinary stock of the amalgamated railway and dock company, the cost of constructing the new Roath Dock, estimated at £500,000, to be defrayed by the company. Making allowance for the present market value of Taff Vale ordinary stock, it would seem that the Bute interest is being bought out at a cost of about £3,000,000."

FORTY YEARS AGO.—One of the former London, Brighton & South Coast Railway's London and the coast, and Continent advertisements reproduced from an American travellers' guide

OVERSEAS RAILWAY AFFAIRS

From our correspondents

ARGENTINA

Suspension of Wage-Cuts on B.A.G.S. and Central Argentine Railways

On December 18 the representatives of these companies officially notified the Director-General of Railways that they had decided to suspend the wage-cuts during the month of December. This resolution is based on the receipts for the quarter ended September 30, and accords with the provisions of the Presidential award. In regard to the future, the question of the resumption of the "cuts" will be decided according to the receipts obtained, [and in accordance with the rulings outlined in the editorial on page 5 of our last issue.—ED. *R.G.*].

National Railway Pension Fund (Amendment) Law

The bill embodying certain amendments in the above law (details of which were given in THE RAILWAY GAZETTE of September 22 and October 20, 1933) is again before Congress. As originally passed by the Chamber of Deputies, the bill provided for a number of important alterations in the law, more particularly with respect to the scale of the monthly contributions, the qualifications for invalid pensions and the assessment of ordinary pensions, but these proposals were subsequently whittled down by the Senate. The Deputies have now refused to accept the Senate's modifications, on the grounds that these are not sufficiently drastic to place the fund on a permanently sound financial basis, and thus avert the danger of ultimate insolvency which threatens it. It is estimated that if the existing regulations are not amended, the entire capital of the fund will be exhausted by 1944.

Pensions of Foreign Pensioners Living out of Argentina

One of the alterations made by the Senate was the rejection of the clause which virtually threatens to deprive retired railway employees of any foreign nationality of their pensions if they decide to live outside Argentina. On this point, however, the Deputies appear to be adamant, insisting that this clause must be retained, despite the obvious hardship and gross injustice which would thereby be inflicted on hundreds of retired railwaymen. The constitutional validity of this clause has been called in question, and such an eminent Argentine jurist as Dr. G. E. Leguizamon (Chairman of the Local Board of the B.A.W.R.) publicly stated that if it were passed, he was prepared to take a test case to the courts at his own expense.

Mr. J. Montague Eddy, C.B.E., the well-known Argentine railway director, who is at present visiting Buenos Aires, in a press interview, expressed his surprise and indignation that such an unwarrantable restriction should be placed on the personal liberty of hundreds of men, many of whom had spent the best part of their lives in Argentina, which they had served faithfully and well in various railway capacities. Mr. Eddy pointed out that the sums actually paid to pensioners living outside the country represented such a small proportion of the total amount that any saving gained by the proposed cuts from foreign pensions would be negligible. Moreover, such a measure would defeat its own object, as under such conditions, the majority of the beneficiaries would naturally return to Argentina in order to be able to collect their full pensions. The bill has been returned for a second reading in the Senate, where a two-thirds majority is required in order to override the decision of the lower Chamber.

INDIA

Gorai Bridge, E.B.R.

Modern traffic requirements have necessitated the replacement of the Gorai bridge on the Goalundo broad gauge main line of the Eastern Bengal Railway. The existing bridge was built by the late Sir Bradford Leslie in 1871. Railway traffic conditions have since undergone vast changes and for some years past proposals for the replacement of this bridge have engaged the serious attention of the railway authorities. Provision for re-building the bridge was first made in the budget for 1932-33, but the work was not taken up, possibly on account of financial difficulties. In the following year, the bridge was strengthened at a small cost, though traffic across the bridge was only maintained under drastic restriction of speed. Even with such restrictions, the passage of trains is becoming unsafe and the Railway Board decided that the construction of a new bridge should no longer be deferred. The new structure was originally estimated to cost Rs. 24 lakhs (£180,000), out of which a sum of Rs. 8 lakhs has been sanctioned for expenditure during 1934-35. The estimates are now being revised, though the preliminary works such as survey, land acquisition and borings are already in progress. It is understood that the new structure will have four spans of 366 ft. and will be located about 400 yd. below the site of the existing bridge. [The existing bridge consists of seven plate girder through spans, each 185 ft. in length, carried on pairs of c.i. cylinders about 10 ft. in diameter, the girders being the largest of their type for their day. As well as being weak, the girders are so spaced that they infringe standard dimensions. —ED. *R.G.*]

Purchase of the Amritsar-Kasur Line

On the recommendation of the North Western Railway administration, the Railway Board has decided to acquire the Amritsar-Patti-Kasur Railway, a broad gauge branch line about 55 miles in length, owned by a private company and operated by the N.W.R. at 45 per cent. of the gross earnings. The share capital of the company is Rs. 33 lakhs in addition to debenture stocks of Rs. 3 lakhs carrying interest at 4¾ per cent. On the estimated purchase price of Rs. 44 lakhs, a net gain of Rs. 3·30 lakhs per annum, equivalent to a return of 7½ per cent., is expected.

1935-36 Construction Budget

A sum of Rs. 20 lakhs will be provided for new construction. Apart from the completion of the Jhudo-Pithoro line started in September, 1934, the only other construction before the Railway Board is a line from Karaikudi to Madura, in South India. If present investigations prove this railway to be remunerative, a sum of Rs. 10 lakhs will be provided for its construction in 1935-36.

SPAIN

Railway Transport Association

On December 5 the Associación General de Transportes por Vía Férrea held an extraordinary general meeting in Madrid, to discuss important questions related to the present position of the Spanish railways. A deputation of the railway managers and representatives afterwards visited the Minister of Public Works, and handed him a note of the conclusions of the meeting. The note contained reference to the uncertainty now existing as to whether the Railway Statute of 1924 is or is not in force, and asked that, as the first step towards a solution of the railway problem, the legal position of the railways should be clearly defined. It was also pointed out that the Bill presented to the Cortes in June, 1934, providing for the reorganisation and regrouping of the Spanish railways into three main groups, was impracticable from all points of view: if approved, it would not be equitable for the companies, the State could not meet the large outlay entailed, and the public interest would be no better served. It was therefore asked that the project be withdrawn from the Cortes. Any solution of the railway problem, it was submitted, should necessarily include,

amongst other things (*a*) a decision as to the operation of the Railway Statute mentioned above; (*b*) authorisation for the companies to issue loans for a term of years greater than the life remaining of their concessions, or in default of this, direct financial aid from the Government; and (*c*) revision of social legislation, taxation and antiquated railway regulations.

In regard to monetary aids, the meeting reminded the Minister of the recommendations of the recent Railway Conference, wherein the necessity was recognised of giving the companies some form of aid until the proposed new Railway Bill should be passed. Amounts voted in the National Estimates for this purpose have not been so used, and it was pointed out that it may be, and often is, more costly for the State to maintain a derelict railway than to lend financial assistance to a private company to keep it alive. Other important points brought forward in the note of the Association referred to the enforcement and extension of the laws relating to road competition, the application of the eight-hour day to the railways, and the guarding of level crossings.

The deputation afterwards visited the Labour Ministry to put before the Minister certain facts relating to the operation of the "mixed juries" or wages boards, and ask that the control of these bodies should be restored to the Ministry of Public Works.

Buffet Cars

The Northern of Spain and the M.Z.A. Railways, in agreement with the International Sleeping Car Company, have announced their intention of putting into service carriages fitted with a refreshment bar (*coches-bar*) for use on lines where traffic is not sufficient to warrant the running dining cars. Each of the railways is now converting seven bogie coaches for this new service, half of the passenger accommodation being removed to make space for the refreshment bar. It is understood that the "rapid" between Madrid and Badajoz will be one of the trains to include a refreshment bar.

U.S.A.

New York, New Haven & Hartford Fast Train

Another high-speed American train was inaugurated on December 8, when a partly streamlined flyer of the New York, New Haven and Hartford Railroad made the 157-mile run from New Haven to Boston in 3 hr. 11 min. Between Providence and Boston the train is reported to have maintained 86 m.p.h. over a four-mile stretch, going on to do the 42 miles into Boston (Back Bay station) in 45 minutes. It was drawn by one of the regular, and not a streamlined locomotive. Observations on the run gave the impression that a speed of 90 m.p.h. could easily be attained. Though the cars comprising this train are of the tubular modern shape, the train is not so streamlined as will be the New Haven's *Rail Zeppelin*, now under construction.

Designed by an American modernistic industrial artist, the coaches weigh one-third less than conventional passenger cars in similar service and are said to be uncommonly quiet, due to extensive use of rubber packing and rubber panels on the floors. The doors open noiselessly and the windows, set in aluminium frames and with packing to exclude dust, are in the form of two separate plates with a dehydrated air pocket between. This prevents the gathering of frost on the outside. The train was built under a two million dollar loan by the Public Works Administration. Fifty such streamlined cars are being built at Worcester, Massachusetts, for the New Haven Road at the rate of one a day.

EGYPT

Electrification Project

The Railway Board and the Minister of Communications having (as announced in the issue of December 28) approved the electrification of the Cairo-Helwan suburban line, the committee appointed to formulate the scheme has recommended the provision of multiple-unit trains and the conversion of the section from El-Saiyida-Zienab to Bab-El-Luq, within the city, to a street railway, on the same principle as the Cairo end of the Heliopolis electric line. The estimated cost of the work is LE.159,280. It is also possible that the Matana line will be electrified, and a cross-city underground connection made between the terminus of this line and that of the Helwan branch.

PORTUGUESE EAST AFRICA

Micheline Railcars

The recent advent of Micheline railcars on the Mozambique Railway (C.F.M.), referred to in THE RAILWAY GAZETTE of July 6 last, has enabled the administration to introduce a general improvement in train services, giving speedier and more frequent facilities on the lines radiating from Lourenço Marques. The Michelines are used principally on the coastal line to Vila Luiza (Marracuene), where 44 trains weekly are now provided in comparison with the former service of only 25. The average journey time has been appreciably reduced and the express service by railcar takes 32 min. for the 22 miles (41·3 m.p.h.), which is one of the fastest schedules in Southern Africa: the previous steam schedule was 57 min. On the Lourenço Marques—Ressano Garcia main line additional services are provided by railcars calling at all stopping places, the speed averaging 34 m.p.h. for the 55-mile journey. On the Xinavane branch, which leaves the main line at Moamba, three railcar services are run weekly, the time taken being two hours less than by the ordinary trains. Eighteen first class passengers are accommodated in the railcar, which contains luggage and toilet compartments, while twelve native (third class) passengers with their luggage can be conveyed in the trailing coach. The trailer is an unusual feature of Micheline railcar operating and is a four-wheeled coach carried on the usual pneumatic tyres: it weighs approximately 3,800 lb. unladen.

PALESTINE

The Boom

Palestine is still booming. The Treasury surplus approaches £4,000,000 and railway traffic returns exceed all expectations. The development is economically sound and the slump—when it does come—is not likely to be so severe as in 1929. The oil pipe line is scheduled to be brought into use this month and the effect of this on the future development of Haifa port is apparent. There remains to be constructed the railway to Baghdad, discussions on which are still proceeding.

As already recorded, Sir Felix Pole is to visit the Palestine Railways this month and there is also to be a Traffic Commission under Mr. C. M. Jenkin Jones, Superintendent, North Eastern Area, London & North Eastern Railway. There is possible scope for reorganisation, as the railways still suffer to some extent from legacies of the military *régime*.

ALGERIA

Taxi-aeroplanes in Algeria

Aeroplane services are now being organised in North Africa. Between Algiers and Oran, return trips, three times a week (Mondays, Thursdays and Saturdays), have already been organised. From January 1, the company has placed an aeroplane at the disposal of passengers landing at Algiers on Tuesdays and Fridays and wishing to get to Oran as soon as possible. If the results of these services are satisfactory, the company plans to establish a daily line to Casablanca, the principal Atlantic port of Morocco, and to Tunis, undertaking at the same time the transport of mail matter and parcels.

According to an Algerian news agency, taxi-aeroplanes are now available in Algeria for daily return trips over a radius of about 300 miles. Two-day flights within a radius of 600 to 1,000 miles or more may also be arranged and would cover journeys to Casablanca and Tunis. Rates are less than taxi-cab fares.

BRITISH RAILWAYS AFTER 25 YEARS

Road competition—Passenger fares—Advertising—Dirty locomotives and stations—London's "Underground"—Signalling developments —Automatic train control—Courtesy of the staff

By C. B. BYLES,

formerly Signal Engineer, Lancashire & Yorkshire Railway, and New South Wales Government Railways

A QUARTER of a century in the life of British railways forms a considerable slice of their history, particularly when the period includes the time of the great war. As an old railwayman who left England for Australia nearly that time ago and who has now for the first time re-visited the home land, the Editor has suggested that it might be of interest to sketch my impressions of the changes that have struck me in the railway systems after so many years. "Impressions" only they must be, and these of the slightest character, as neither time nor opportunity has been available for more exact observation, still less for anything in the nature of criticism.

Rail Safety and Road Accidents

The thing above all others in regard to the railways which strikes one returning after long absence from England is the growth of road competition. It is amazing to find the English roads and lanes thronged with vehicles actively competing with the railways both in goods and passenger traffic. Amazing, too, is it to find the British public, once so sensitive in the matter of public casualties, taking so calmly the road dangers which this has brought about and the fearful toll of life which is occurring week by week. In my years of railway service I have been associated with a good many railway accidents but, when a mishap occurred, with however small a casualty list, we had an unhappy feeling that we might be falling down on our job and all sorts of trouble was taken to avoid the risk of a recurrence. Now that the fiery untamed motor has been let loose in the country side and slaughters its hundred and fifty victims each week, to say nothing of those which it maims and cripples, the public seems not to turn a hair. I have even heard it suggested that by this means is afforded a useful contribution to the solution of the problem of unemployment.

This is not the place in which to attempt any discussion of road competition, but one cannot but hope that it will not be long before the great national asset which the country possesses in its railways will again be utilised to its full capacity. I have noticed a frequent outcry in the press for the improvement of the roads which were admittedly never intended for the sort of traffic which they are now called on to carry; but surely a prior need is to make possible the fullest use of the railways, which are expressly constructed for fast and heavy traffic and are undoubtedly still capable of development in both respects.

Cheap Ticket Anomalies

Turning to the railways themselves, the railwayman of former years is naturally impressed by the weight of the express trains of to-day, the general speeding-up which has taken place, and the excellent timekeeping. At one time double-heading was an everyday feature on our main lines, but is now scarcely ever seen. The public seems to be catered for in every conceivable way, particularly in the matter of through services and in the provision of restaurant cars. The passenger fares, however, strike one as rather in the nature of a joke, and the railways appear to work on the principle of the Dutch auction, lowering the price until a customer bids. No doubt in this the psychology of the public is well understood, as people are always more willing to buy when the price appears to be lower than it might be. The statutory fare lists are apparently little regarded, in fact, sometimes the fare lists bear a notice begging the would-be traveller first to consult the booking clerk as to the tempting bargains displayed inside! But the multiplicity of fares at various rates must surely cause a good deal of bookkeeping complications and, what is worse, must open the door to possibility of fraud. If a return ticket costs little more than a single one, there must be temptation to get a friend at the other end to oblige in the matter of the return half, for a consideration. The climax, however, is reached in a case which came under my notice in which the return fare was actually less than the single fare, and another one in which "cheap single" tickets were available. As, in neither case, did the cheaper fare involve any less facility, one is left wondering who are the simple souls who in such circumstances nobly pay the ordinary fare!

Conservatism versus Modern Advertising

To one brought up in the conservative school of British railways in the nineteenth century and accustomed to the decorum and reserve inculcated in those days, the present-day advertising methods and the many ways in which a reluctant public is wooed to the use of the railways appear rather undignified. The innumerable posters now to be seen are certainly attractive, and many of them have real artistic merit, but some of them are scarcely worthy to be the spokesmen of a great national undertaking and inevitably convey the suggestion that the flippancy in the advertisement may be associated with flippancy in the service offered. In one case I was shocked beyond words to observe slung round the engine chimney of a famous express a caption reminiscent of a Barnum and Bailey show! However, far be it from me to criticise, but I fear that some of our former railway managers must be having an uneasy time in their graves as the result of these modern advertising methods!

More Smoking

A few minor points of interest to the old-timer fall here to be mentioned. One alteration in the national habits is reflected in the greatly increased accommodation for smokers which is now given in the trains as compared with years ago. The lot of the unfortunate non-smoker, whether man or woman, has indeed become a hard one, and he is lucky who, after careful search, can find a compartment free from his pet abomination. The growing practice of marking non-smoking compartments as such is, however, helpful and does something to mitigate his hard lot.

The stations are certainly not as smart and well-kept as they were in former days, and doubtless the need for economy has limited the activities of the paint brush.

The London terminals, in particular, are not the splendid palaces they were in the days of my youth, and one famous station in particular, from which in former years it was a pure joy to set forth on a journey, has descended now to a very ordinary level.

So, too, with the locomotives. I fear that, except in some cases, the ancient glory of the British locomotive, as a thing of beauty, has departed, another result of hard times. One can but hope that, when the motor fiend has been put in its proper place, it will be possible once more to make our engines an example to the world in the matter of good looks.

Mention should be made of the underground railways of London, which have greatly developed since my day and which strike one as marvels of organisation and efficiency. The multitude of devices provided for the convenience and assistance of the public are beyond praise, and it is an education to observe the marvellous way in which the crowds are handled and disposed of. To this result there contributes, as one of the most important factors, the signalling system of these railways, which for efficiency and reliability is probably unequalled.

One detail in which the railways of the old country have not progressed as might have been expected came under my notice when, travelling by an express train, the locomotive failed. The services of a goods engine standing at a wayside station had to be requisitioned and, as this was not fitted with the continuous brake, the passenger train had to be worked to the next depot with hand brakes only. I am, of course, aware of the large mount of goods stock in England which is still unfitted, but it seems remarkable that a modern goods engine (which this apparently was) should not be fully equipped.

Signalling

This brings me finally to the subject of signalling, upon which I may perhaps claim to speak with rather more particularity. The general impression which is conveyed, on returning to English railways after so many years, is that, considering the time that has elapsed, the progress has not been as rapid as might have been expected, but it must be recognised that circumstances have been quite against anything in the nature of wholesale reconstruction. The one outstanding example of a completely homogeneous signalling system built up on the most modern and comprehensive lines is found in the London underground railways. There nothing is wanting to afford the conditions of safety and facility for which a signalling system should stand. The results speak for themselves and say everything for the skill with which the system has been designed and carried out and is maintained.

Where the more modern methods are being introduced on the other railways, two characteristics are noticeable. The first is the apparent hesitancy to take full advantage of the potentialities which they offer, the newer methods being merely grafted on the old, with the result that many of the advantages which they offer, in the way of simplification and increased facility, have often been missed. In this connection it is to be feared that the dogmas of that hoary old classic, the Standard Rule Book, have too often stood in the way of greater progress. The second point noticed, and this applies more particularly to the introduction of colour light signals, is the serious want of uniformity which is creeping in as between the various railways. Dating from the Regulation of Railways Act of 1889 or even earlier, signalling practice on British railways has been uniform so far as its outward aspects are concerned, and it will indeed be a matter for regret if new systems of colour signals are adopted, differing on each of the railways, and even, it is said, on sections of the same railway. I believe that a committee is now engaged in trying to evolve a uniform system, and it is to be hoped that it will arrive at some satisfactory conclusion before the diversity has gone too far to be readily rectified.

The Significance of Thirsk

To my mind, the most significant development in respect of modern power and automatic signalling is to be found in the installation on the L.N.E.R. main line at Thirsk. Here, as your readers will remember, numerous junctions and considerable sections of main line are controlled from one signal box. There are no levers and no mechanical locking, the whole of the functions being controlled by switches mounted on a diagram within convenient reach of the signalman's hand. The interlocking is wholly electrical or, to be precise, there is no interlocking, the functions being each circuit-controlled by means of multiple relays. The flexibility of such an arrangement is at once evident and the safeguards provided may be, and in this case are, exactly the same as those available in any installation in which point and track-circuit control is given. I venture to think that it is on lines such as the Thirsk installation that the future development of power signalling may be looked for.

Two other matters in connection with signalling practice have struck me. One is the advantage that has been taken of colour light signals for use during fog. Some companies make use of the signals themselves and others have special light signals for use in foggy weather only. In either case the results are highly satisfactory and, as they extend, the use of light signals will do away with the nuisance of manual fog signalling and detonators.

Automatic Train Control

The other matter to which I would refer is the curious silence on the subject of automatic train control. Some twenty years ago the subject was all to the fore. The Government inspectors in their reports frequently pointed out that the provision of automatic train control might have prevented mishaps and, if my memory serves, a committee was appointed to make recommendations on the subject. Now in England, so far as my observation goes, no forward move is being made in the matter, except on the Great Western Railway, where its own cab signalling system is in extensive use. Indeed, in one instance a fairly extensive train control plant is now disused and has been taken up.

In concluding this slight survey of impressions made upon me by English railways, after an absence of so many years, I would like to express the conviction that in one respect British railways stand pre-eminent as they always have. I refer to the uniform courtesy and helpfulness of the staff. Surely nowhere else in the world can you find the men engaged in the working of the railways so efficient, so extraordinarily helpful, and so uniformly polite.

POINT-OPERATING MACHINES FOR RAILWAYS.—The latest B.S. Specification for railway signalling apparatus deals with the performance tests for electrically-driven point-operating machines. Speed of operation is all-important, but speed must be accompanied by the ability to exert sufficient thrust to overcome the resistance due to ice, snow or other obstruction. It is understood that the times of operation and the thrusts laid down in the specification were arrived at as the result of an extensive series of tests carried out by and on behalf of the B.S.I. Committee with the co-operation of the four main-line railway companies and the L.P.T.B. In addition to the performance tests, the specification deals with the general features of construction, with a view to securing a standard range of machines which will be satisfactory for all normal service requirements on British and overseas railways. Copies of this specification (No. 581—1934) may be obtained from the British Standards Institution, 28, Victoria Street, London, S.W.1, price 2s. 2d. post free.

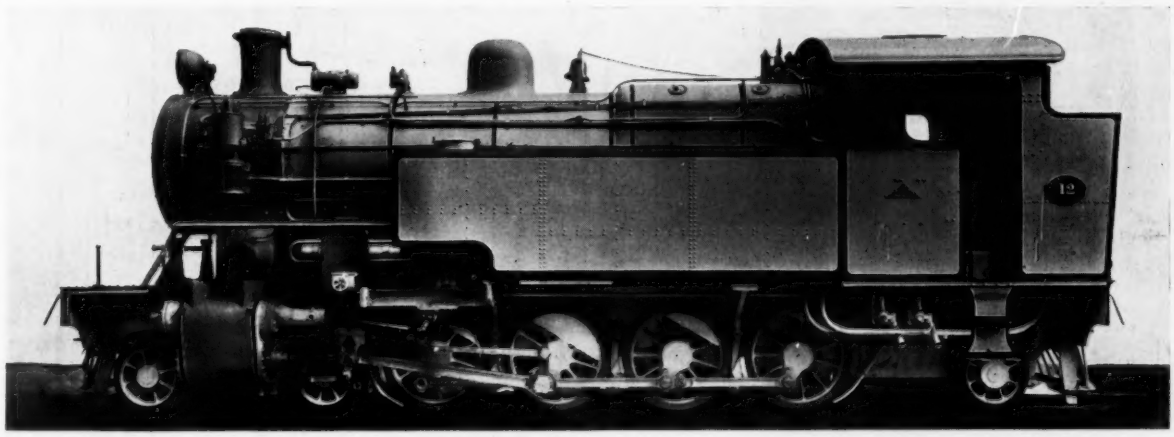
NEW BRITISH-BUILT LOCOMOTIVES FOR OVERSEAS RAILWAYS

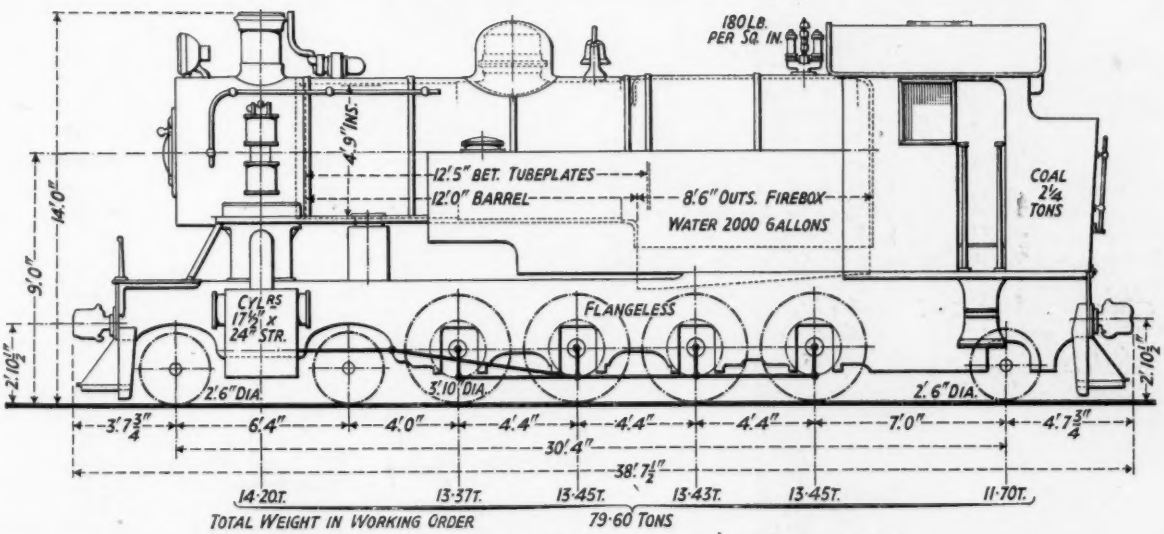
A standard gauge 4-8-2 *tank engine for Jamaica and metre gauge* 4-6-0 *locomotives with tenders for India*

NEW locomotives as above have recently been constructed by Nasmyth, Wilson & Co. Ltd., of Patricroft, Manchester. The tank engine has been built to the requirements of the Director of the Jamaica Government Railway under the supervision of the Crown Agents for the Colonies. It has outside cylinders driving the second pair of coupled wheels, steam distribution being effected by superimposed piston valves actuated by Walschaerts gearing.

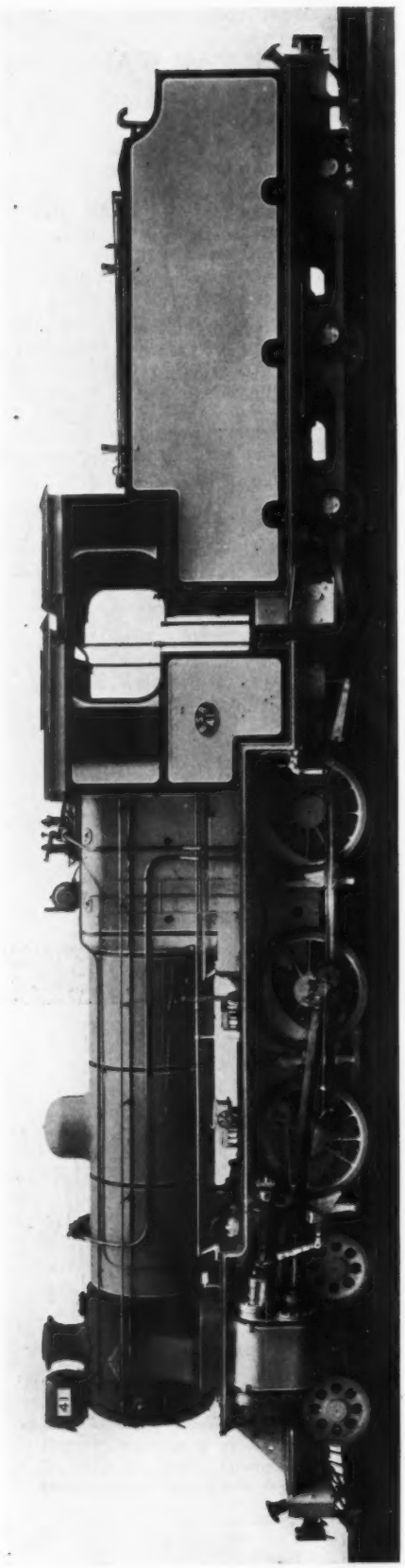
The boiler has a steel inner firebox with Dunic steel water space stays. Steel tubes are used, these being welded to the tube plate at the firebox end. Longitudinal stays have been dispensed with, and the upper areas of the front tubeplate and firebox back plate are supported by means of plate girder stays. The front two rows of roof stays are fitted into short floating girders supported on the tubeplate and the third row of roof stays so as to allow for the rise at the front of the box. This arrangement is used in place of the normal expansion stays. The grate is of the rocking and drop type.

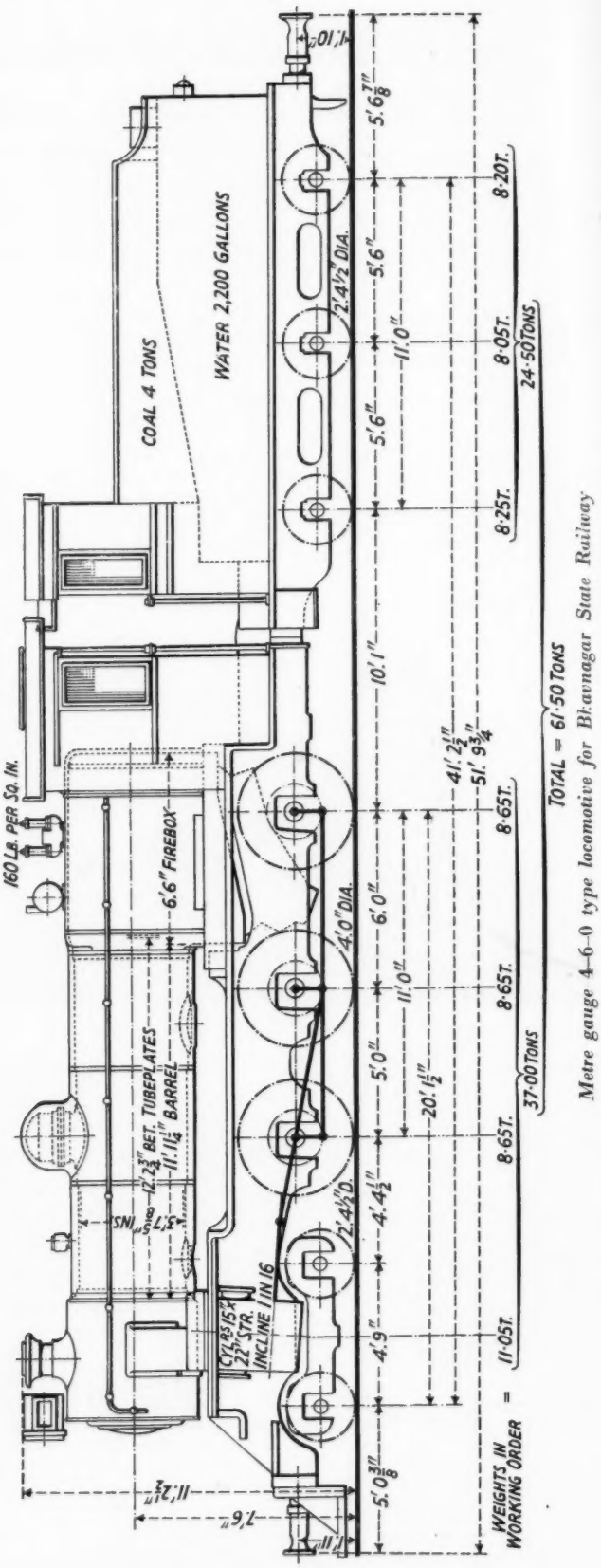
The connecting rod big ends are of the floating bush type and the coupling and connecting rods are fitted with bushes of Anti-Attrition bronze supplied by The Anti-Attrition Metal Co. Ltd., this material also being used for the motion bushes and for the liners and bushes of the axlebox guides. The bogie is compensated to provide for its movements on the severe reverse curves and to facilitate the negotiation of curves generally the intermediate and driving wheels are flangeless. The coupled axleboxes are of cast steel fitted with crown bearings. A special feature is the keep, which is arranged so that it may be removed without lifting the boxes. These axleboxes are lubricated by a Wakefield mechanical lubricator and a five-feed Eureka hydrostatic lubricator of the same



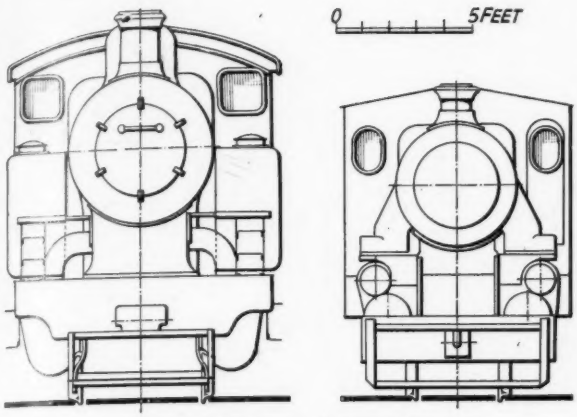


Standard gauge 4–8–2 *type tank engine, Jamaica Government Railway*





Metre gauge 4–6–0 type locomotive for Bhavnagar State Railway



Front end views of locomotives

firm's manufacture is also fitted for feeding the valve chests, cylinders and Westinghouse pumps with pressure lubrication.

The following are the leading particulars:—

Cylinders (2) diameter	17½ in.
,, piston stroke	24 in.
Wheels, couped, diameter	3 ft. 10 in.
,, leading and trailing diameter	2 ft. 6 in.
Wheelbase, coupled	13 ft. 0 in.
,, total	30 ft. 4 in.
Boiler, heating surface, firebox	144·5 sq. ft.
,, ,, ,, tubes	1,397·5 sq. ft.
,, ,, ,, total	1,542·0 sq. ft.
Grate area	26·5 sq. ft.
Boiler, working pressure	180 lb. per sq. in.
Weight of engine in working order	79·6 tons.
Adhesion weight	53·7 tons.
Tractive force at 85 per cent. b.p.	24,446 lb.
Rate of adhesion to tractive force at 85 per cent. b.p.	4·92

The tanks accommodate 2,000 gallons of water and a fuel space of 103 cubic ft. is afforded, taking 2¼ tons of coal.

The locomotive is required primarily for service on branch lines and occasionally on the main line. The gradients on the lines worked over are severe, 4½-mile grades of 1 in 30 being encountered in combination with uncompensated reverse curves of 18 deg. without any intermediate straight sections. It is the practice of the railway to widen the gauge from ¾ in. to 1 in. on all curves sharper than 10 deg. (537 ft.).

The equipment of the locomotive includes, in addition to items already mentioned, the following components: — Ross pop safety valves; Clyde Superior soot blower fitted on the firebox back plate; Sellers type injectors supplied by Gresham & Craven Limited; United States metallic piston packing; magnesia block lagging supplied by J. W. Roberts Limited; Westinghouse brake; couplers of the M.C.B. type supplied by The English Steel Corporation, and electric lighting equipment of the L.B.B. type incorporating a Tonum headlight supplied by J. Stone & Co. Ltd.

The locomotives for India are of the 4-6-0 type with six-wheeled tenders and are for the Bhavnagar State Railway. They, two in number, were built to the instructions of the Consulting Engineers, Robert White & Partners, London, S.W.1.

Poppet Valve Locomotive for Bhavnagar

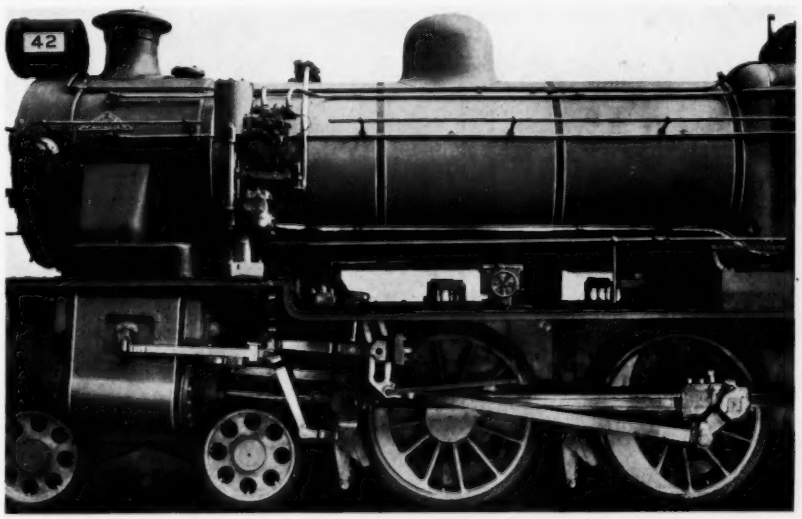
Outside cylinders driving the middle pair of coupled wheels are employed, one of the engines being equipped with piston valves and Walschaerts gearing and the other with O.C. poppet valve gear. In addition to the usual equipment, the engines are fitted with a Gresham & Craven injection feed water heater, the poppet valve locomotive also having a Weir feed pump, in conjunction with a top feed device. The engines are designed with wide fireboxes above the frames instead of, as previously, narrow boxes between the frames. This has the effect of increasing the grate area by approximately 30 per cent. To facilitate this conversion the coupled wheels were reduced from 4 ft. 9 in. to 4 ft. 0 in. diameter.

The leading particulars are as follow:—

Cylinders (2) diameter	15 in.
,, piston stroke	22 in.
Wheels, coupled, diameter	4 ft. 0 in.
,, bogie, diameter	2 ft. 4½ in.
Wheelbase, rigid	11 ft. 0 in.
,, total engine	20 ft. 1½ in.
Boiler, working pressure	160 lb. per sq. in.
,, heating surface superheater inside	140 sq. ft.
,, ,, ,, tubes	704 sq. ft.
,, ,, ,, arch tubes	9 sq. ft.
,, ,, ,, firebox	87 sq. ft.
,, ,, ,, total	940 sq. ft.
Grate area	20·7 sq. ft.
Weight in working order (engine)	37 tons.
,, ,, (tender)	24·5 tons.
Total weight in working order	61·5 tons.
Adhesion weight	25·95 tons.

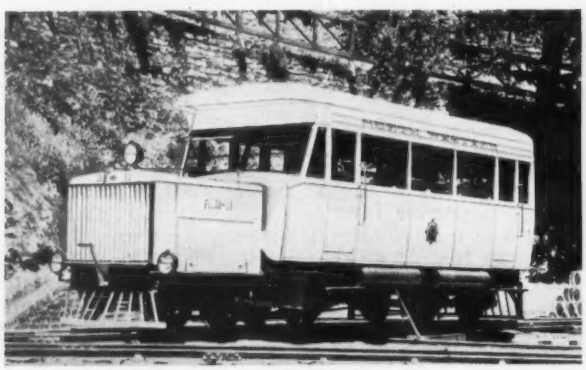
At 85 per cent. of the boiler pressure, the engine develops a tractive force of 14,025 lb. and the ratio of adhesion to tractive force at the same percentage is 4·14. The tender has a tank capacity of 2,200 gallons of water and a coal capacity of 4 tons (180 cubic ft.). Wash out doors have been fitted at the bottom of the tender to facilitate cleaning out.

Sunbeam electric lighting apparatus and Vacuum brake gear are fitted; the safety valves are of the Ross poppet type and a Wakefield mechanical lubricator is used for lubricating the cylinders and steam chests.



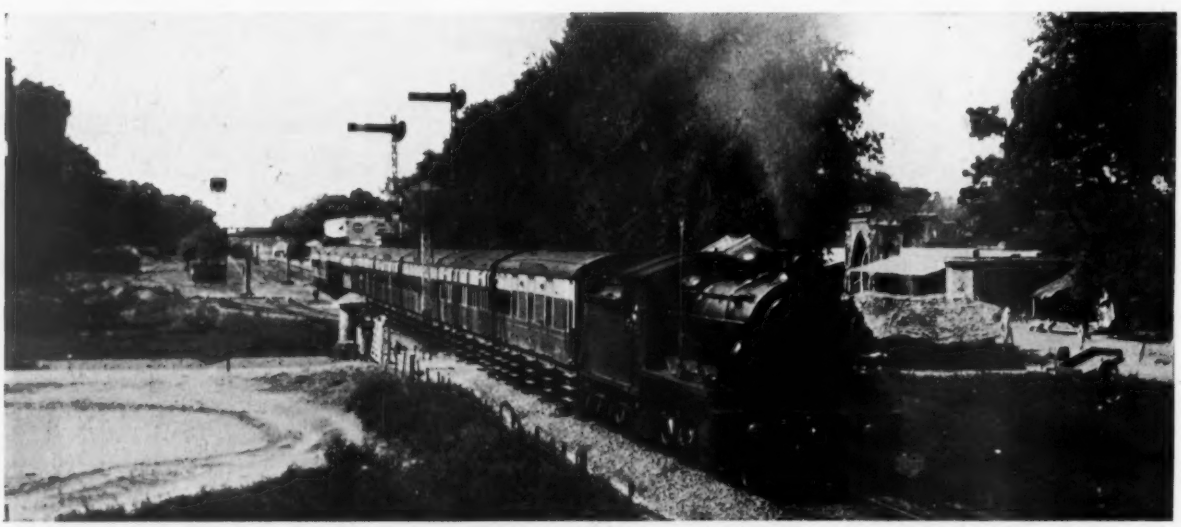
The second of the 4-5-0 Bhavnagar locomotives, No. 42, showing the O.C. poppet valve gear and Weir feed pump

East Indian Railway Lucknow Express



Petrol railcar on Kalka-Simla section, N.W.R.

Simla station with down mail train ready to start



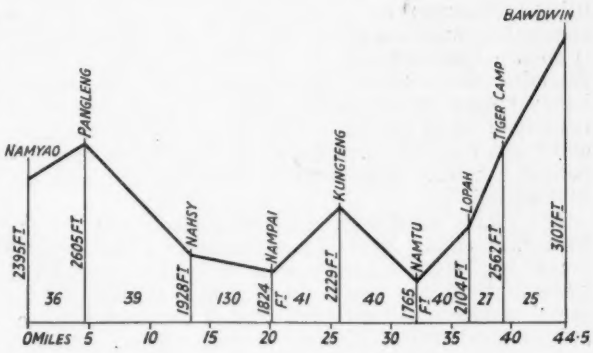
Punjab Mail from Peshawar to Calcutta passing over the East Indian Railway hauled by 4-6-0 type locomotive

RAILWAY SCENES IN INDIA

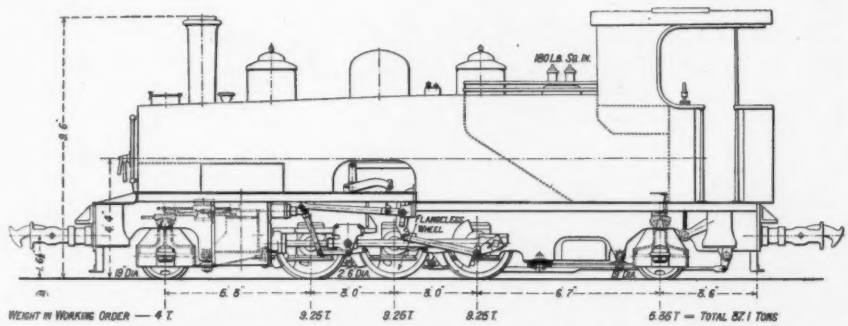
LUBRICATED CHECKRAILS TO REDUCE CURVE WEAR

On the 2 ft. gauge Burma Corporation Railway the problem of rail and tyre wear on sharp curves has been solved by checkrail lubrication

TO the north-east of Burma proper on the borders of China lie the Northern Shan States where the Burma Corporation Limited carries out mining and smelting operations at Bawdwin and Namtu respectively. The Burma Railways metre gauge system runs through Namyao, 548 miles from Rangoon and from there the Burma Corporation's 2 ft. gauge line runs for 32 miles to Namtu and 44 miles to Bawdwin. Between Namtu and Namyao three or four trains run daily in each direction, consisting of 11 to 14 bogie wagons with a gross tonnage of 200 to 240 tons hauled by two locomotives of which the second is placed behind the fourth wagon. Between Namtu and the mine ore bins there are six to eight trains daily and, the grade being in favour of the load, one locomotive hauls 14 wagons with a gross load of 400 tons. Between the concentrating mill and the smelter there is an electrified section operated by articulated 4-4-4-4 type electric locomotives weighing 35 tons and exerting 15,700 lb. tractive effort. All the axles of these locomotives are driven. The total ton-mileage of the corporation's railway system is approximately 14,000,000 per annum.



Sketch gradient profile Namyao to Bawdwin, Burma Corporation Railway



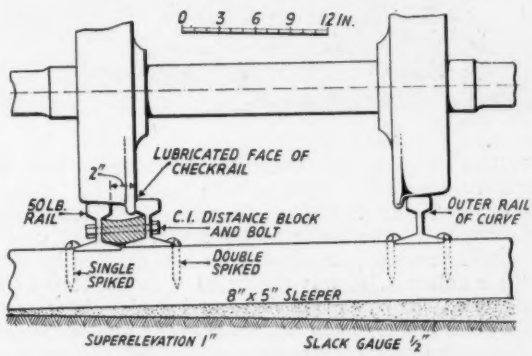
2-6-2 *Bagnall tank locomotive, Burma Corporation Railway*

The line runs through mountainous country with heavy grades and severe curves, the sharpest of which is 106 ft. radius, and 47½ per cent. of the line is curved. The main line locomotives are Bagnall 2-6-2 superheater tanks of which a diagram is shown herewith. The rigid wheelbase is 6 ft., and the centre coupled wheels, 2 ft. 6 in. diameter, are flangeless. The tractive effort at 75 per cent. of the boiler pressure of 180 lb. per sq. in. is 12,168 lb. The rolling stock consists of steel bogie wagons carrying 7½ tons per axle. The bogie wheelbase is 3 ft. 6 in., and the bogie centres are 19 ft. apart. The diameter of the tyres is 18 inches.

The track was relaid in 1927-28 with new 50 lb. B.S. flat-footed rails laid on hardwood sleepers measuring 5 ft. × 8 in. × 5 in., 2,500 a mile. All curves of 180 ft. radius or less were checked, the checkrail being set at 2½ in. from the running rail and held thereon by ¾ in. bolts passing through cast iron distant pieces spaced at 6 ft. centres. The gauge was widened by ½ in. on these curves.

Rail wear was heavy from the outset and increased in severity as the rails became worn to wheel profile. A careful survey made three years after relaying showed that the average wear on all curves was 6 lb. per yard and on some curves reached 10 lb., which was the maximum permissible. At this rate the average further duration of useful service left in the outer rails on curves was 20 months, making a total of only 56 months' life. Immediately after relaying the locomotive tyres wore to a minimum gauge in about 14,000 miles, but as the rail wear increased this mileage progressively decreased and one locomotive went to minimum in 3,300 miles. The average total service obtained from locomotive tyres three years after relaying was about 10,000 miles. Wagon wheels at this time had a life of 27 weeks only.

A trial was made of bringing the checkrail in to 2 in. clearance from the running rail, and this relieved the outer rail from flange wear but gave so much resistance on curves of less than 130 ft. radius that the trains became



Arrangement of lubricated check rail relieving outer rail on curve of side thrust and wear

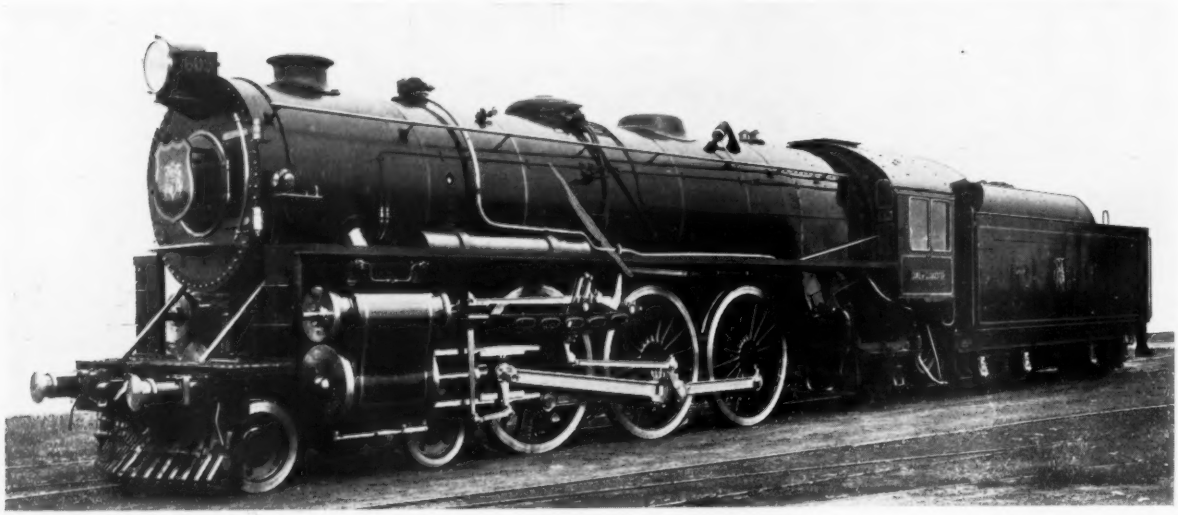
stalled. To overcome this difficulty experiments were made with lubricating the side of the checkrail and this was successfully accomplished by using a thick sticky asphaltic oiling compound. All the checkrails were then brought in to the 2 in. clearance, and as the $\frac{3}{4}$ in. bolts were found to be too light they were replaced by $\frac{7}{8}$ in. bolts which proved amply strong. There are now nine miles of lubricated checkrails on the 39 miles of track between Namyao and Tiger Camp, and the average monthly consumption of oil is 157 gallons. The lubricant is applied from a hand operated oiling trolley in which the thick oil is heated and delivered to pads pressing lightly against the checkrail. Until the inner face of all the wagon wheel flanges had been coated with lubricant, oiling was required frequently. No trouble has been experienced by the transfer of oil from the check to the running rail.

The results have been most satisfactory and, as the outer rails of the curves do not come into contact with the wheel flanges, the only wear is head wear and rail renewals have not yet been necessary after about six years' service. The straight sides of the wheel flanges carry a good coat of lubricant through which the smooth polished face of the steel may be seen. The locomotive driving wheels are now skimmed over after 15,000 miles, not because the flanges are worn too thin but in order to true up the tread and reduce the depth of the flange to normal. Their total life is now more than 60,000 miles and the wagon wheel life has been increased from 27 weeks to more than 100 weeks. To sum up, the life of locomotive tyres has been increased five-fold and that of wagon wheels four-fold, and there is no observable wear on the checkrails.

With 50 lb. B.S. rails the rail footings need not be cut to obtain the 2 in. clearance, nor should they be cut to allow for driving spikes between the check and the running rail. The latter should be single-spiked on the outer side and the former double-spiked on the inner side. When the hardwood sleeper is chamfered to give the 1 in 20 rail cant the checkrail will lie about $\frac{3}{4}$ in. higher than the running rail, which is an advantage, as it gives a better surface of rail face in contact with the wheel flange. On very sharp curves this is liable to cause trouble if the locomotives have any flangeless wheels, as they may occasionally ride the checkrail. The spacing of the distance blocks and bolts and the clearance between running and checkrail will naturally be governed by the type of locomotive used and the curvature, and should be carefully chosen. The rail joint on the checkrail is a point of lateral weakness and may be strengthened by passing a bolt through the fishplate of the check and the web of the running rail.

4-6-2 EXPRESS LOCOMOTIVES, SOUTH AUSTRALIAN RAILWAYS

Locomotive No. 609 as decorated with the Royal Coat of Arms for use by the Duke of Gloucester during his Australian tour



THE accompanying illustration shows engine No. 609, a Pacific, 4-6-2 type, express locomotive belonging to the South Australian Railways which was used on the occasion of the Duke of Gloucester's recent visit to the Commonwealth, on which occasion, as already stated in these columns, it was decorated with the Royal Coat of Arms on the smokebox door, and a plate bearing the name *Duke of Gloucester* was fixed to the side of the cab.

This locomotive belongs to a series, the first of which was built in this country in 1926 to the designs of Mr. F. J. Shea, Chief Mechanical Engineer, South Australian Railways, the builders being Sir W. G. Armstrong, Whitworth & Co. Ltd. The design incorporates two 24 in. by 28 in. cylinders, coupled wheels 6 ft. 3 in. diam., total heating surface of boiler 3,966 sq. ft., grate area 55 sq. ft., boiler pressure 200 lb. per sq. in. The total weight of the engine and tender in working order is 200 tons, of which 72·35 tons rank for adhesion. The engine develops a tractive force, at 85 per cent. of the boiler pressure, of 36,600 lb. The tender, which is of the eight-wheeled double bogie type, carries 8,000 gallons of water and 12 tons of coal.

RAILWAY NEWS SECTION

PERSONAL

SOUTHERN RAILWAY STAFF CHANGES

The following appointments have been made to take effect in the Engineer's Department as from January 1, 1935:—

Mr. C. A. G. Linton to be Assistant Engineer, (General Maintenance) Waterloo.

Mr. F. E. Campion to be Divisional Engineer, London East.

Mr. W. A. Messer, Permanent Way Assistant, retired on December 31 last.

COLONIAL OFFICE APPOINTMENTS

The Secretary of State for the Colonies has recently made the following appointments:—

Way and Works Department, Ceylon Government Railway.

Mr. G. E. Samuels, Deputy Engineer, to be Engineer;

Mr. J. E. S. Bodger, Assistant Engineer, to be Deputy Engineer;

Mr. J. L. Sanders, District Engineer, to be Assistant Engineer.

Stores Department, Kenya & Uganda Railways & Harbours

Mr. D. P. Cousin, Chief Storekeeper, Tanganyika Railways, to be Stores Superintendent, K. & U.R. & H.

From the *London Gazette* of January 1, 1935: Regular Army: Corps of Royal Engineers:—Major H. W. Wagstaff, M.C., to be Lieutenant Colonel (December 31, 1934). Lt. Col. Wagstaff is Supervisor of Railway Labour, Indian Railway Board.

It is with regret that we note the death, on January 7, of Sir James Alfred Ewing, K.C.B., F.R.S., late Professor of Applied Mechanics at the Universities of Cambridge, Dundee and Tokyo, late Director of Naval Education, and late Principal and Vice-Chancellor of the University of Edinburgh. Sir Alfred was President of the British Association in 1932 and during the war he had charge of the since famous "Room 40" at the Admiralty, where the German secret codes were deciphered, constantly giving warning of inestimable value of the movements of the German fleet. But railway engineers, both civil and mechanical, will know him best as the compiler of some of the most widely used text books on the steam engine, strength of materials and applied mechanics. He was 79 years of age.

Sir Archibald Page, M.I.E.E., M.Inst.C.E., who, as announced in our issue of December 14, has been appointed Chairman of the Central Electricity Board, took up his new duties on January 1. For many years one of the leading figures in the electricity supply industry in Great Britain, Sir Archibald has been closely identified with the work of the Board since it was set up in the spring of 1927, having been its first General Manager. He is a native of Alloa, Scotland, and was educated at Dollar Academy, the Heriot-Watt College, Edinburgh, and the Royal Technical College, Glasgow. He first became associated with the supply industry as a member of the staff of the Glasgow Corporation Electricity Department, and from 1905 to 1917 was the Deputy City Electrical Engineer. In the latter year he joined the Clyde Valley Electric Power Company and became General Manager. When the Electricity Commission was constituted in 1920 to devise means for unifying the electricity supply of Great Britain, Sir Archibald Page was chosen to act as one of the five Commissioners, and he occupied that office for nearly five years. In 1925 he relinquished the post upon accepting the offer of the position of Director and General Manager of the County of London Electric Supply Co. Ltd., the largest undertaking of its kind in Greater London. After the passing of the Electricity (Supply) Act of 1926, Sir Archibald joined the Central Electricity Board as its General Manager and has seen the construction of the Grid completed and the system brought into operation. During recent years the Southern Railway Company has embarked on the extensive programme of railway electrification embracing *inter alia* the Brighton main line and it has fallen to Sir Archibald's lot to take part in the negotiation of contracts for the power supplies for these developments. Hitherto in these matters the Central Board has acted as an intermediary between the railway company and the electricity supply authorities, but under the Electricity (Supply) Bill which has passed the House of Commons and now awaits consideration by the House of Lords at the end of January, it is proposed to empower the Board to supply electricity direct to railway companies for traction purposes. Sir Archibald, who received his knighthood in 1930, has been a member of the Institution of Electrical Engineers for many years and during the session 1927/28 he occupied the Presidential Chair. He is also a member of the Institution of Civil Engineers.

Elliott [*& Fry*

Sir Archibald Page, M.I.E.E., M.Inst.C.E.,

Appointed Chairman of the Central Electricity Board

Mr. A. S. Rinder, having accepted the position of Managing Director of Alfred Bird & Sons Ltd., Birmingham, relinquishes his executive duties as Manager of the London District Office of Metropolitan-Vickers Electrical Co. Ltd., but remains a Director of that company. Mr. D. MacArthur, Manager of the Metrovick Glasgow office, succeeds Mr. Rinder as Manager of the London District office, and has taken up his new duties as from January 1.

Major G. R. S. Wilson, who, as announced in our issue of January 4, has been appointed an Assistant Inspecting Officer of Railways, Ministry of Transport, was educated at Marlborough and the R.M.A., Woolwich. He was commissioned in the Royal Engineers in November, 1914, and after six months

at the School of Military Engineering, Chatham, proceeded to France in May, 1915. He served in Field Companies there and in Macedonia throughout the war. After returning to the School of Military Engineering for a post-war course, and subsequently commanding a Field Company in Ireland, he was employed on topographical survey on the Syria-Palestine Boundary Commission in 1921. Thereafter he served with the Railway Troops at Longmoor till 1924, during which time he was also in charge of the Catterick Military Railway and was attached to the S.E. and C. Railway for a course of training of a year's duration in various departments. From 1924 to 1930 he served in the Directorate of Movement at the War Office and thereafter was on foreign service at Malta for two years.

Major G. R. S. Wilson, R.E.,

Appointed an Assistant Inspecting Officer of Railways, Ministry of Transport

On his return he rejoined the Railway Training Centre at Longmoor and underwent a further course of a year on the Southern Railway in 1932-33, subsequently becoming an Instructor at the Railway Training Centre, the position he now vacates to go to the Ministry of Transport.

Mr. C. A. G. Linton, M.Inst.C.E., who, as announced above, has been appointed Assistant Engineer (General Maintenance), Southern Railway, served his apprenticeship with J. and R. Houston, of Greenock, and gained further experience of heavy structural steelwork with Arrol's Bridge & Roof Company, Glasgow. In 1899 he entered the service of the London Brighton & South Coast Railway in the New Works Department, but in 1902 transferred to the Bridge Section of the Engineer's Department, South Eastern & Chatham Railway. In 1914 Mr. Linton was appointed Resident Engineer for the construction of the Military Base at Boulogne, under the supervision of Mr. (afterwards Sir) Percy C. Tempest, K.B.E., which work was undertaken by the South Eastern

Mr. C. A. G. Linton, M.B.E., M.Inst.C.E.,

Appointed Assistant Engineer (General Maintenance), Southern Railway

& Chatham Railway for the War Office. In this connection Mr. Linton received the M.B.E. From 1917 to 1918, Mr. Linton's services were lent to R. Robinson & Company, of Westminster, and he acted as Resident

Mr. F. E. Campion, A.M.Inst.C.E., Assoc.Inst.R.S.E.

Appointed Divisional Engineer, London East, Southern Railway

Engineer in charge of various works in France carried out by that firm. On his return to railway service he was appointed District Engineer in charge of the Tonbridge District, S.E. & C.R. in 1920 and in 1923 he was transferred to take charge of the London East Division of the Southern Railway, the position he now vacates to go to Waterloo as Assistant Engineer (General Maintenance).

Mr. F. E. Campion, A.M.Inst.C.E., Assoc. Inst.R.S.E., who, as announced above, has been appointed Divisional Engineer, London East Division, Southern Railway, is the son of the late Mr. F. A. Campion, M.Inst.C.E., Chief Engineer, Great Northern Railway, Ireland, and was educated at Seafield, Bexhill and Uppingham. He began his career in 1912 as a pupil under his father and later under Mr. C. J. Brown, C.B.E., Chief Engineer, G.N.R., England. During 1914-15 he held a commission in the Royal Engineers (Special Reserve). Mr. Campion was appointed as an Assistant on the Great Northern of Ireland in 1916, and four years later joined the London, Brighton & South Coast Railway as Resident Engineer on the Oxted tunnel repairs. In 1921 he was transferred to East Croydon as Assistant District Engineer. After the amalgamation he became Assistant Divisional Engineer, London East Division, Southern Railway in 1923, and remained there until his transfer to the Head Office, four years later. From 1930-33 Mr. Campion was Assistant for Special Works and from 1933-34 was Assistant to the Chief Engineer, the appointment he now relinquishes to go to London Bridge in charge of the London East Division.

Dr. L. P. O'Farrell,

Appointed Chairman of the Local Board, Buenos Ayres & Pacific Railway

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Dr. Luís Patrick O'Farrell has been appointed Chairman of the Local Board of the Buenos Ayres & Pacific Railway, in place of the late Dr. Angel Gallardo.

Dr. O'Farrell thus succeeds to the position formerly occupied by his father, the late Dr. Santiago G. O'Farrell, who was Chairman from 1913 to 1926. Dr. O'Farrell was born in Buenos Aires in 1890, studied law and was called to the Argentine Bar in 1912. In 1929 he was elected a Local Director of the Argentine Transandine Railway, and on the death in 1931 of Dr. Raul S. Zavalia, he became Chairman of the Local Board. In this capacity he took an important part in the negotiations with the Chilean Government over the question of the cattle duties, which brought about the temporary suspension of the service in 1932, and it was due to his influential exertions that the line was eventually reopened. He is Vice-Chairman of the Local Board of the Primitiva Gas Company, a Director of the Union Telephone Company, and a Local Director of the Western Telegraph Company. He has been a Member of the Local Board of the Buenos Ayres & Pacific Railway since 1931.

At the request of the Palestine Government, Mr. C. M. Jenkin Jones, Superintendent North Eastern Area, L.N.E.R., left York for Palestine on January 10, to advise and report on matters concerning the railways in that country. The L.N.E.R. has arranged to release Mr Jenkin Jones from his ordinary duties for a period of three months.

Mr. L. B. Unwin, Comptroller of the Canadian Pacific Railway, has been appointed Vice-President and Treasurer in succession to Mr. E. E. Lloyd, who retired on December 31 under pension rules. Mr. E. A. Leslie has succeeded Mr. Unwin as Comptroller. Mr. Unwin, who was born in Kent, England, joined the C.P.R. in 1908, and saw service with the Canadian Expeditionary Force from September, 1914, to June, 1919.

Mr. H. D. Anderson, who, as recorded in last week's issue, retired on January 4 from the position of Assistant Divisional Superintendent, London, G.W.R., was, on the 3rd, presented with an inscribed silver cigarette box by the members of the Pooling Sub-Committee of the four main line railways. The presentation was made at a meeting at Broad Street by Mr. W. O. Davies, Assistant District Goods Manager, L.M.S.R., Chairman of the Pooling Sub-Committee.

We regretfully note the death, on January 5, of Mr. J. W. Shores, C.M.G., sometime Engineer-in-Chief of the Natal Government Railways and a pioneer of railway construction in South Africa. Mr. Shores did great work in restoring damaged lines during the South African war, and for this was awarded the C.M.G. Born in 1851 and educated at Lancing, he was appointed by the Crown Agents for the Colonies as an Assistant Engineer on the Natal Government Railways in 1876, and helped to build the first Natal line from Durban to Pietermaritzburg, and subsequent extensions. Afterwards he was Superintending Engineer in charge of the important international link, which, under agreement with Dutch interests, was built by the Natal Railways in foreign (Transvaal) territory, from Charlestown to Johannesburg, thus providing an outlet from the Rand goldfields to the sea at Durban. He became Engineer-in-Chief in 1897 and retired in 1910.

INSTITUTE OF TRANSPORT

The following have been elected Corporate or admitted as Non-Corporate Members of the Institute during December :—

Corporate Member : Mr. H. Cheadle, Chief Traffic Manager, South African Railways and Harbours.

Corporate Associate Members : Messrs. E. H. R. Clarke, Rhodesia Railways ; H. A. J. Day, Port of Bristol Authority ; P. H. Fisher, G.W.R. ; J. R. F. Gibson, Pickfords Limited ; and W. Rothwell, L.M.S.R.

Non-Corporate Graduates : Messrs. B. F. Auger, A. R. D. Burns, R. E. Clark and F. W. Harvey, L.N.E.R. ; S. Bolton and J. A. Williams, L.M.S.R. ; J. H. C. Brennan, T. G. Coleman, L. Gamble and E. J. Long, G.W.R. ; L. Dawson, Cheshire Lines Committee ; R. J. Hogan, Port of Calcutta ; P. G. Joubert, South African Railways and Harbours ; S. C. Leeson, Thomas Cook & Son, Ltd. ; and A. E. O'Dowd, English Electric Co. Ltd. and Trevor Williams Limited.

Non-Corporate Students : Messrs. E. E. Allman, New South Wales Government Railways ; L. J. Brown, Southern Railway ; R. V. Frost, E. L. Rowlandson and G. B. Shorrock, L.M.S.R. ; H. J. Herriott, G.W.R. ; L. G. Scutt, L.P.T.B. ; and B. M. Thakur, Kenya and Uganda Railways and Harbours.

Mr. S. H. Hunt, formerly Vice-President of the L.M.S.R., left estate valued at £35,186 (£26,224 net).

We learn with regret of the recent death of Mr. T. R. Johnson, former Chief Commissioner of Railways in New South Wales.

Lt.-Col. M. McC. Bidder, D.S.O., M.Inst.C.E., M.I.Mech.E., formerly a Director of Kitson & Co. Ltd., left estate valued at £4,672.

With regret we note the death, on December 24, of Mr. William Garrow, sometime Traffic Superintendent of the old Highland Railway.

Mr. J. Montague Eddy, C.B.E., a Director of the B.A.G.S., B.A.W. and B.A. & Pacific Railways, arrived in Buenos Aires on December 2, on a business visit.

Mr. P. B. Wilson, Chief Accountant, Southern Railways of Peru, has proceeded to England on leave.

Mr. Charles Case, Locomotive Running Superintendent, Central Argentine Railway, sailed for England on leave on November 28.

Mr. J. A. Dunnage, A.M.Inst.T., has now taken up his duties as full-time secretary of the Industrial Transport Association at the newly-established offices of the Association in Chandos Street, Buckingham Gate, London, S.W.1.

Colonel Charles F. Hitchins, D.S.O., M.I.Mech.E., M.I.N.A., has been appointed to the Board of the Skinningrove Iron Co. Ltd., to fill the vacancy caused by the retirement of Mr. Claud E. Pease.

Mr. Stuart Ainsworth has been appointed Manager of the Guaqui-La Paz Railway, Bolivia, as from November 1, vice Mr. C. V. Sampson, who has been transferred, on promotion, to Arequipa, as Traffic Manager of the Southern Railway of Peru.

INDIAN RAILWAY STAFF CHANGES

Mr. C. P. Colvin, O.B.E., Member of the Railway Board, has been granted 18 months' leave preparatory to retirement as from November 20, 1934. Mr. A. E. Tylden-Pattenson, Agent of the G.I.P.R., has been appointed to officiate as Member in his place and from the same date.

Mr. G. A. Hicks, V.D., Chief Engineer, Burma Railways, has been granted two years' leave as from December 4 last, preparatory to retirement.

Dr. R. V. Clayton, Principal Medical Officer, G.I.P.R., returned to duty from leave on October 26.

Mr. J. Royal has been appointed to officiate as Deputy Chief Accounts Officer, G.I.P.R., as from November 5, 1934.

Mr. S. G. H. Shah has been appointed to officiate as Deputy Chief Commercial Manager N.W.R., as from November 1, 1934.

Mr. W. H. H. Young, on return from leave, assumed charge as Divisional Superintendent, E.I.R., as from November 9, 1934.

Mr. E. L. Manley has been promoted as provisionally permanent Deputy Chief Engineer, State Railways, with back effect from May 24, 1934.

Dr. S. C. Chatterjee, Chief Medical Officer G.I.P.R., joined the E.B.R. as Chief Medical Officer on November 3, 1934.

Mr. F. G. S. Martin, on return from leave, assumed charge as Controller of Stores, E.I.R., on October 14, Mr. A. R. A. Hare Duke, reverting as Deputy Controller.

Mr. A. Cooper, Deputy Chief Commercial Manager, N.W.R., has been appointed to officiate as Chief Commercial Manager on that railway as from November 1, 1934.

Mr. C. E. Chase, on return from leave, has assumed charge as Chief Mechanical Engineer, B.-N.R., relieving Mr. A. M. Robertson, who has reverted to Superintendent, Equipment, thus relieving Mr. J. Humphries, who, in turn, has reverted to Superintendent, Mechanical Workshops.

Lagny Railway Disaster Trial

(From our Paris correspondent)

A year ago, December 23, 1933, the railway disaster on the main line of the Eastern Railway of France near Lagny, 17 miles from the Paris terminus, caused the death of over 200 persons and inflicted injuries on as many more. Georges Daubigny, the engine driver of the Strasbourg express which ran into and wrecked the slowly moving Nancy train, was arrested immediately but soon released largely in response to public opinion. Pending his trial on a charge of homicide by imprudence, Daubigny has been re-employed by the Eastern Railway Company as a driver of slow passenger trains. The trial began at Meaux on December 19 and lasted three days. Judgment will be delivered on January 24.

During the past year one of the judges of the court at Meaux, aided by railway technical experts, has conducted a careful inquiry into all the circumstances of the accident. A parallel inquiry was carried on by State official experts on behalf of the Government. Charges were originally brought against some officials of the Eastern Railway but these were dropped in accordance with the evidence given by the experts. The only charge remaining was the one against Daubigny. The inquiry showed that Daubigny had a clean record in a service extending over 24 years. He had never passed a danger signal. He has steadily maintained that the signals near Lagny all showed line clear and his statements have been supported by Charpentier, the fireman.

Alleged Overrunning of Signals

At the trial the presiding judge, M. Pernot, brother of M. Georges Pernot, the present Minister of Justice, told Daubigny that the public prosecutor charged him with overrunning signals in a moment of inattention, and with imprudence in having driven the Strasbourg express at an excessive speed considering the foggy conditions. The judge called his attention to the signalling rule that safety must depend solely on the direct and visual observation of the signals and not on devices confirming the signals by sound, such as the detonators and the whistle or siren in the locomotive cab.

In such foggy weather, continued the judge, the driver ought to have reduced speed. He knew that loss of time on that account would involve no penalty. Drivers of the trains in advance of the Strasbourg express had all reduced speed. According to the experts, the failure to observe the signals was the principal, if not the sole cause of the disaster. They did not accept the driver's statement that he saw four signals showing white lights, all indicating "clear." The question before the court comes down to this, said the judge: "Were the signals open (off) or closed (on)?"

Repetition of signals by means of the "crocodile," or ramp on the track, which actuates the whistle in the cab, or by means of the semaphore detonator, are only supplementary precautions, said the judge, and must not be relied upon alone. The sole requisite and obligatory signals are those seen along the line. Daubigny drove the express at a speed of 100 to 102 km.p.h. (about 62½ to 63½ m.p.h.), as if he had not seen the warning signals which caused the Nancy express ahead of him to slacken speed and stop. He had been driving expresses since 1929 and his superiors, who spoke in high esteem of his capacities, could not believe that he had passed four signals in forty seconds.

The Driver's Statement

Daubigny explained that he had received no special instructions on account of the fog. He had started from Paris at normal speed and drove without hesitation as he was able to see signals about 20 to 25 yards ahead of the locomotive, although the fog was troublesome at times. His speed was in accordance with the regulations. The judge remarked that comparison of his graphic record with those of the trains ahead showed that they had all reduced speed because of the atmospheric conditions, and that he alone had continued at a high speed. When Daubigny replied that the signals gave line clear, the judge said that it remained to be determined whether he had seen all the signals. The whistle had not sounded in the locomotive and the detonator had not been heard, except in the rear of the train, but such signals were merely supplementary.

The Fireman's Evidence

Charpentier, the fireman, was the first witness called. Eight months ago his eyesight was found to be affected by Daltonism, or colour blindness. He could not distinguish yellow from green. On the night of the accident he had seen the two white lights at Vaires station. At kilometre 23.97 he saw the *damier* (repeater) open about 50 yards ahead. He had not seen the red lights at the rear of the Nancy express but he saw Daubigny suddenly put on the brakes. Fuselin, driver of the wrecked Nancy express, said that he ran his train at 110 km.p.h. (about 69 m.p.h.) as far as the Chelles cutting. There he slowed down to 50 km. and then to 5 km.p.h., not on account of the fog, but because the distant, or caution, signal was against him.

Representing the State official control, M. Gaudin, engineer expert, handed in that body's report. He held that Daubigny was responsible for the accident. Travelling at 102 km.p.h., he had less than a second to see the signals. A single glance at the inside of his cab would be sufficient to prevent him seeing the signals outside. He missed four signals because he was going too fast. It was impossible to admit that they all fell out of order just at the moment of the disaster, and then immediately began operating normally again. The signal relays had been removed and submitted to laboratory tests under similar low temperature conditions. They had been operated 40,000 times in succession without failure, thus disproving the theory that the parts might have become stuck together by frost. In reply to questions by defending counsel, the expert admitted that a coating of ice on the crocodile might have prevented the electric current from passing, and thus the warning whistle would not be sounded in the cab of the locomotive.

Averted Collision Alleged

In the second day's proceedings, evidence was given by Robert Leroy, principal electrician of the permanent way department, who appeared as a delegate of the safety personnel. He said that for years failures of signals had been noted. He considered it possible and even probable that Daubigny had found the signals open (off). On the very night of the Lagny disaster, a similar accident had been narrowly averted at Meaux itself. When the Château-Thierry train stopped in the station at Meaux, the signals did not operate to cover the rear of the train. Fortunately a railwayman noticed the fact and ran along the line with his red lamp to stop an oncoming express. He cited other instances of signals failing. He blamed the use of wood instead of steel coaches as responsible for converting the accident into catastrophe. The witness added that there were sufficient steel coaches in the Ourcq depot, but he alleged that the policy of rationalisation had left insufficient fitters available to prepare the coaches and thaw-out frozen fittings. On this point an official of the company said later that even if the parts had been thawed out on the night in question they would have frozen again immediately. Four other witnesses testified that in inspecting the line after the collision they found the four signals passed by Daubigny were in the "on" position.

Chief Engineer gives Evidence

M. Bouché-Leclercq, Chief Engineer, Way and Works, Eastern Railway, explained that the crocodiles were not very reliable, especially in the case of fast expresses when the time of contact with the brush and electro-magnetic apparatus under the locomotive would not be more than one-tenth of a second. But he added that the failures of optical signals were infinitely less

numerous. The Eastern Railway system had 40,000 optical signals each operated 500 times daily. The number of failures was insignificant. M. Charles Richard, Chief Engineer of the Government Inspection Department, said that the control had conducted very minute investigations. They had found all the signalling installations in good condition. For the four signals to have remained open (off) instead of going to "danger" or "caution" behind the previous train, there must have been two sources of failure, the one electrical and the other mechanical. The chances of simultaneous breakdown as shown by statistics were one to three in a million tests. Theoretically such a catastrophic chance could not happen more than once in a million years. He concluded that the engine driver was solely responsible.

Case for the Prosecution

In the final proceedings on December 21, the public prosecutor presented the case against Daubigny with great moderation. He said that the court could feel sympathy with him after his many years' faultless service and might find extenuating circumstances. But when Daubigny maintained that the signals were in the "off" position, this did not mean that he had seen them all, and the court must decide between the driver's statements and the opinions of the experts. The public prosecutor concluded that he was convinced of Daubigny's imprudence in driving his train at excessive speed through the dense fog.

After deliberation, the court decided to defer giving its judgment until January 24.

Ministry of Transport Accident Report

Winwick Junction, London Midland & Scottish Railway : September 28, 1934

The facts of this accident are probably remembered. While a local train from Warrington to Wigan, via Earlestown, was moving forward slowly from the home signal for the down fast line up to the signal-box to learn why the home signal for the Preston direction was lowered and not that for Earlestown, it was run into by the 5.20 p.m. express from Euston to Blackpool, travelling at its normal speed of about 50 m.p.h. Ten passengers and the guard of the local train were killed; the driver of the local train was so seriously hurt that he could not give his evidence to Colonel Trench, who conducted the Ministry of Transport inquiry, until November 14.

The local train consisted of three bogie coaches, drawn by a 2-4-2 tank engine, chimney leading. The express had nine bogie vehicles and was drawn by 4-6-0 engine No. 25648, "Prince of Wales" class. The last coach of the local train was completely demolished and the second was seriously damaged. The two leading coaches of the express were badly telescoped and totally wrecked; the remaining seven suffered only trifling damage. These seven, but not the other two, had shock-absorbing buffers. It is noted that after the clearance of the wreckage the engine of the express was able to move under its own steam and to draw some of the damaged vehicles away. The only point we need mention as to the signalling is that the view of trains standing at the home signals is somewhat obstructed by the east pier of the foot overbridge, so that they are not as conspicuous to a casual glance as if they were standing on an entirely open section of line, but a signalman has no difficulty in seeing either an engine by day, or its headlight by night, if he actually looks for it.

The local train was offered by Winwick Quay to signalman Bloor at Winwick Junction at 8.57. Bloor accepted the train and received Train-entering-section about 9.3. At this moment his attention was occupied by movements of other trains, and he did not, as he should have done, offer it forward to Vulcan Bank signal-box at once, and therefore did not pull off his home and starting signals for it.

Driver Hope, of the local train, stopped a short distance in rear of the home signal, about 9.6, and told fireman Hayes to go to the box to carry out rule 55. While Hayes was on the way, Winwick Quay signalman had intimation that the express was approaching, and, as his block instrument to Winwick Junction still showed *Train on Line*, called the attention of signalman Bloor, with a view to signalling Shunt-train-for-following-train-to-pass. Bloor heard the Call-attention bell, and, looking at his block instrument, saw that it was still at *Train on Line*. Forgetting about the local train, he thought that he had omitted to give Train-out-of-section for the preceding train which had passed on to the branch some eight mines earlier. He immediately gave Train-out-of-section to Winwick Quay, and was then offered and accepted the express, and having offered it forward to and obtained acceptance from the next box, set the road and pulled off his signals for it.

Responsibility for this accident must rest upon signalman Bloor, and he frankly admitted this without attempt at evasion. During the few minutes before the accident he had to deal in rapid succession with eight trains, several of which involved conflicting movements at the junction, and several also involved telephonic arrangements with various other boxes.

The entries in the block book at Winwick Junction are kept by a signal box lad, E. Derbyshire, who had been employed in this signal box for 18 months. He had completed the entries for the North Wales to Manchester *via* Earlestown express, which passed at about 8.56 and had entered the acceptance of the down local passenger from Winwick Quay, when he was called to the telephone to take particulars of certain alterations in excursion train running. Having received this information he went to the other end of the signal box to refer to the special weekly notice about these trains and to enter the alterations thereon.

As Derbyshire returned to his desk he heard Bloor remark "Goodness, I have not given 2-1 here yet" and he gave Train-out-of-section on the down fast instrument to Winwick Quay, and immediately afterwards was offered and accepted the express. As already noted, Bloor had forgotten the local passenger train and thought that he had failed to give Out-of-section for the preceding North Wales express. On hearing this remark and bell signal, Derbyshire assumed that the local passenger, for which he had booked only the one entry of *Line Clear* given to Winwick Quay, must have passed the box while he was speaking on the telephone, and he therefore entered in the book what he considered to be normal intermediate timings for the passing of the train and its acceptance ahead, &c., without questioning Bloor about this.

Signalman Bloor's failure to remember the local train can be ascribed only to mental lapse, and his action in sending Train-out-of-section without verification was a most serious breach of the basic principles of block working. He agreed, as is evidently the case, that he was much pressed at the time,

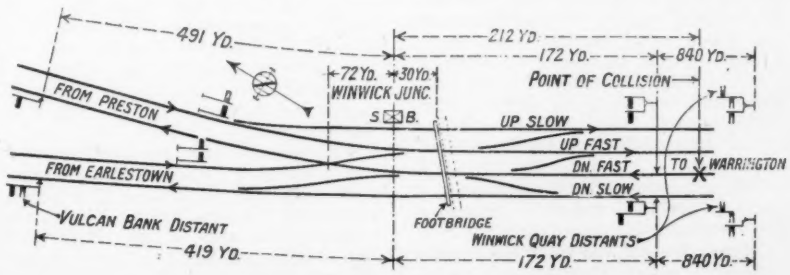


Diagram showing point of collision

but he did not suggest that the work in this box was unduly heavy. He said that, generally speaking, the early evening hours were the busiest time of the twenty-four. He had been on duty since 2.0 p.m. on the day of the accident. He is a man of 55 years of age, with 34 years' service as signalman and 21 years at Winwick Junction. He has a good record, and, apart from his frank admission of responsibility, it should be noted that after the accident he kept his head and made all possible arrangements for obtaining prompt assistance.

If this had been a box in which the signalman had to make his own entries in the block book, Colonel Trench feels that Bloor would hardly have failed to look at this book before he gave Train-out-of-section, or at any rate immediately after, and he would thus have been reminded of the local train. A booking lad has no responsibility in connection with train operation, and the very unfortunate coincidence at this moment of the telephonic communication and action thereon made matters more difficult for Derbyshire; but had he on hearing Train-out-of-section, reminded Bloor that the entries for the local train were incomplete, or asked him what time it had passed or had been accepted ahead, it would probably have been in time for Bloor to take action to avert the accident, and it was very unfortunate that Derbyshire did not do so. One of the objects served by a block-register is to remind a signalman of the situation at any moment, but unless the booking is accurate, it is worthless and even misleading. Colonel Trench suggests, therefore, that it would be desirable for the company to ensure that all booking lads should realise that if, owing to any interruption, they have to make entries other than from personal knowledge, they should make quite certain of their substantial accuracy by inquiry from the signalman.

After acquitting the driver and fireman of the express of any responsibility for the accident, and adding that, in the circumstances he sees no reason to doubt that driver Hope and fireman Hayes took all proper steps to carry out promptly the provisions of rule 55, and that no delay occurred such as might have been a contributory cause of this accident, Colonel Trench proceeds to say that the accident would have been prevented by the provision of a track circuit in rear of the down fast home signal, which would have indicated to the signalman at Winwick Junction the presence of the local train, and, with suitable locking, this would have rendered it impossible for him to accept the express from Winwick Quay. The provision of track circuiting at points such as this is a common practice which is becoming more general every year.

Colonel Trench was informed by the company's officers that a track circuit at this point had been included in an extensive list of such proposals some two years ago, but that they had naturally to place these proposals in order of urgency, having regard to all the factors concerned; this case was low on the order of urgency, in view of the proximity of the home signal to the box, the reasonably good view, and the fact that it was seldom necessary to hold a train at this signal, if a train had to be held at this box, the usual practice would be to allow it up to the starting signal and thus clear the junction; a track circuit has been provided in rear of the down main starting signal to cover this contingency. In the last few years the company has made very rapid progress with the provision of track circuit generally, but the circumstances of this accident do emphasise the safety value of such equipment and provide a cogent reason for the further extension of track circuit in this and similar places, especially at junctions on four-track lines. The Inspecting Officer is not prepared to criticise the company's decision as to the order of urgency of this particular track circuit, but thinks that the proposed reconstruction of this box and modernisation of its equipment, referred to below, should not be long delayed.

It is probable also that a fireman's call-box at this signal, as is already provided at the adjacent down slow home where trains are frequently detained, would have averted the accident, but the same considerations apply generally, and in this case a track circuit would have been a more suitable form of protection. The reconstruction of Winwick Junction signal box was in a programme of works which had been submitted shortly before the accident and which is likely to be carried out in the near future. The scheme proposed includes the provision of track circuiting in rear of all the stop signals concerned, with suitable interlocking, in addition to the interlocking of the block instruments with the starting signals in rear, in accordance with the latest standard practice of this company in main line boxes.

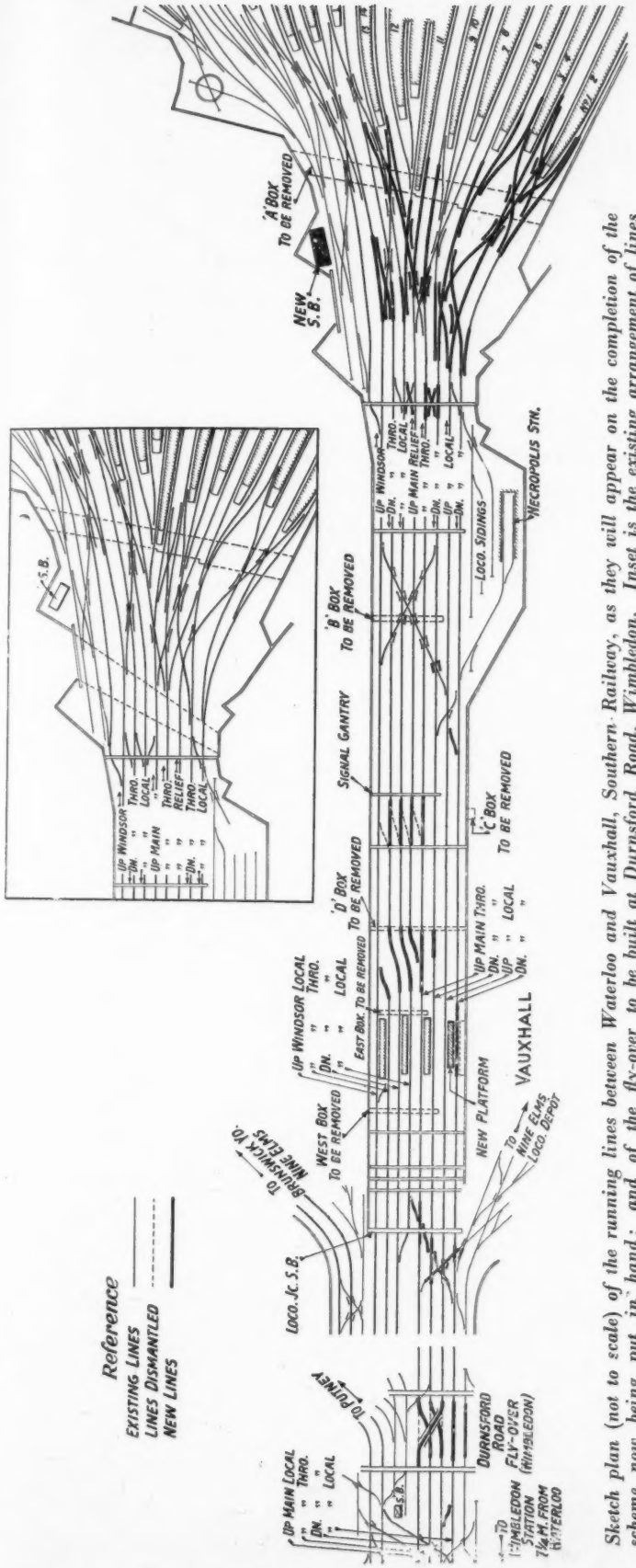
Colonel Trench concludes his report as follows: I have suggested earlier in this report that the company should take steps to remind signal box booking lads that they must satisfy themselves of the substantial accuracy of any entries which are not made from definite first-hand knowledge. With the exception of this minor point, and on the assumption that the reconstruction of Winwick Junction box referred to above is likely to be included in the 1935 programme, I have no recommendation to make as the result of this accident.

The question of all-steel rolling stock has been under discussion in connection with this accident. For many years past the standard practice of the company, as also of the other main line companies, has been to construct all new passenger stock on heavy steel underframes; of the L.M.S. stock approximately 80 per cent. is now of this type, and during the last six years the bodies on these underframes have had steel ends and steel panels on timber framing, approximately 2,300 vehicles, while since 1932 the roofs also have been of steel, approximately 1,200 vehicles, which are being added to at the rate of about 600 per annum. Of the total weight of the latest coaches of all four main line companies, about 75 per cent. is steel.

The merits of this type of construction, *viz.*, heavy steel underframes and substantial timber—or steel and timber—bodies, as compared with heavier all-steel construction, have been considered by the railway companies as recently as February of last year, when, subsequent to the Lagny disaster, they confirmed their opinion that for British conditions the present method of building is generally the most satisfactory from the point of view of public safety. It must be remembered that if a collision occurs at high speed the force of impact must be absorbed in some manner, and the inevitable result of an unyielding form of coach construction would be to throw the coaches bodily in all directions, probably in the usual star formation, with greater risk of injury to all the occupants.

The Inspecting Officers have considered the question on several occasions during the last few years and are in agreement with the opinion expressed by the companies, always provided that progress is maintained in conversion to electric lighting, and that frames, buffers, couplings, vestibules, &c., are so constructed as to reduce the liability to telescoping to a minimum. The results of an accident at high speed are largely fortuitous, and it seems preferable to devote available resources to measures for the prevention of accidents rather than to minimising their results. The last seven coaches of the express were all fitted with special shock-absorbing buffers in accordance with the standard practice of this company, and these must have been an important factor in the comparatively trifling nature of the damage to these coaches.

PROPOSED NEW BRIDGES OVER DANUBE LINKING ROUMANIA AND JUGOSLAVIA.—Reports from Bucharest indicate that Roumania and Jugoslavia are shortly to be connected directly by railway. The two Governments are planning to build two railway bridges over the Danube which forms the frontier between these countries. The first bridge will link Turnu-Severin in Roumania with Kladova in Jugoslavia. The cost, which is estimated at 400,000,000 lei (about £800,000), will be equally divided between the two countries. The bridge should take three years to build. The other bridge will connect Panzevo in Jugoslavia with the Roumanian bank of the Danube opposite. It is expected that work will be begun on it in May next.



Sketch plan (not to scale) of the running lines between Waterloo and Vauxhall, Southern Railway, as they will appear on the completion of the scheme now being put in hand; and of the fly-over to be built at Durnsford Road, Wimbledon. Inset is the existing arrangement of lines approaching the platforms at Waterloo station

The £500,000 Waterloo Scheme, Southern Railway

In an editorial note in our issue of September 7 last, we announced the decision of the Southern Railway to improve the approach to Waterloo station by rearranging the eight running lines on the alternate up and down principle; installing colour light signalling between Waterloo and Hampton Court junction, and a power-operated signal box at Waterloo; and constructing a flying junction at Durnsford Road, Wimbledon. The total cost of the scheme is approximately £500,000.

Further details of the arrangements have now been issued by the Southern Railway, and we are also able to reproduce alongside a diagram of the tracks as they will appear when rearranged. At present Waterloo station is used to its utmost capacity, and by reason of the famous bottle-neck between Vauxhall and Waterloo a complicated system of crossover roads has to be used. The transposition of the running lines will result in the following:—

The down local line will remain as at present;
The present down through line will become the up local line;
The up through line will become the down through line; and
The up local line will become the up through line.

The effect of this will be that trains from Kingston, Hampton Court, and so forth will be taken from the present up lines over to the present down side, giving direct access to their respective platforms at Waterloo, thus avoiding the crossovers at present used and releasing the main track for the occupation of main line and other trains.

In addition to the engineering work involved in constructing the fly-over at Durnsford Road the track and crossovers between Waterloo and Vauxhall will be revised. The present down main local platform at Vauxhall station is to be removed and replaced by a new island platform between the down main local line and what is to become the up main local line. Each running line at Vauxhall will thus have a platform face.

An important part of the scheme is the installation between Waterloo and Hampton Court junction of three-aspect colour light signalling as is at present extensively used on other parts of the Southern Railway suburban system and also on the London-Brighton main line.

The installation will involve the replacement of the present manual signal box at Waterloo by an electrically worked box, similar to those at London Bridge, Cannon Street, and Charing Cross stations.

The transposition of the tracks, together with the installation of the colour light signalling, will make possible the running of trains at intervals of from 2 to 2½ minutes as compared with the present margin on this section of 4 minutes.

Proposed New Signalling, Boroughbridge Branch, L.N.E.R.

The factors which should determine the salient features of a signalling system are the speed and density of traffic. As a rule, equal protection is provided on branch and subsidiary lines to that on main lines, though the conditions are radically different. Accepting the view that the amount of protection provided should bear some ratio to the risks obtaining, provided, of course, the risks in each case are covered so far as is humanly possible, the L.N.E.R. directors have agreed to replace the signalling system on the Boroughbridge branch by a novel and ingenious arrangement, which should go far to assist in solving the problem of branch and minor lines.

The Boroughbridge branch is a single line operated by train staff and ticket, connecting with the main line at Pilmoor and the York-Harrogate line at Knaresborough Goods junction. The distance between Pilmoor and Knaresborough is 12 miles, and there are three intermediate stations; at each of which facilities exist for shunting freight traffic. There is very little traffic on the branch, and normally the service is performed by four locomotives. These will be fitted with powerful electric headlamps, fitted with 6 V. 24 W. lamps and illuminated from accumulators carried on the engine.

The arrangements at stations will be as follow:—The existing train staff and ticket working will be retained and the necessary duties in connection therewith carried out by the person in charge of the station. All signals, locking frames, &c., will be dispensed with. At a position corresponding to the usual distant signal will be fixed a location marker, consisting of a horizontal board, 7 ft. 6 in. long, 18 in. deep, and 5 ft. 6 in. from rail level, at right angles to the line, well above rail level, painted with diagonal black and yellow stripes and equipped with $\frac{7}{8}$ in. dia. hemispherical white reflex lenses arranged in zigzag fashion. Corresponding to the home signal is the Section Limit Board. This board is fixed vertically, 5 ft. 6 in. from rail level, the top being about 9 ft. above rail, is 6 ft. 3 in. by 1 ft. 6 in., and painted with red and white diagonal stripes. The outline of the board is fitted with $\frac{7}{8}$ in. dia. hemispherical white reflex lenses in rectangular form, whilst three clusters of red reflectors, $5\frac{1}{2}$ in. overall dia., are provided within the rectangle; these consisting of nine $1\frac{1}{2}$ in. dia. flat red reflectors. All trains must come to a stand at the Section Limit Board unless given authority to enter the station. At the station will be fitted a board known as the Station Board, 4 ft. square, and of height as required. This on one side is provided with a flap which uncovers a square green board for day use and which permits a green light to be exhibited at night. Where only one board is provided, this answers only for one direction of traffic. The board will be operated *in situ* by the person in charge of the station.

As regards shunting operations, points will be operated by ground levers, by the train crew, the points being interlocked with the train staff and tickets where necessary. At level crossings caution stop or gate boards are provided, the caution and stop boards being operated by the crossing keeper and interlocked with the gates. The caution board corresponds to the usual distant signal and consists of a board 4 ft. square, centre 5 ft. 6 in. above rail level, and painted white with yellow and black checker squares and fitted with $\frac{7}{8}$ in. dia. white hemispherical reflex lenses showing the word "Gate." When the board requires to be cleared it is swivelled on a horizontal axis, the edge only being visible to a driver. The stop board corresponds to the usual home signal and consists of a similar board but painted white with red diamond and fitted with $\frac{7}{8}$ in. dia. red hemispherical reflex lenses showing the word "Stop." The method of clearing this board is exactly similar to that of the caution board, where interlocked boards are not provided. Two gate target boards are fitted to the gates to show in each direction, either along the rail or roadway. These consist of a board exactly similar to the Gate Stop Board.

The various boards form quite distinctive landmarks by day, whilst at night the indications given by the reflection of the beam from the engine headlight, by the reflectors, is most striking and efficient.

* Abstracted from a paper by Mr. A. E. Tattersall, Signal and Telegraph Engineer, North Eastern Area, L.N.E.R., on "The Trend of Development in Railway Signalling," presented yesterday (January 10) to the York Lecture and Debating Society.

L.N.E.R. 1935 New Rolling Stock and Works Programme

The L.N.E.R. has now announced its 1935 programme, following those of the G.W.R. and L.M.S.R. recorded in last week's issue. New locomotives to be built total 88, of which 39 will be 0-6-0 tender freight engines of class J39, 35 three-cylinder 2-6-0 mixed traffic locomotives of class K3, and 14 engines the design of which has not been finally decided upon, but which are specially intended for heavy long-distance work. All these engines will be of the general utility type, capable of hauling excursion trains, fast trains and fast brake-fitted freight trains. A total of 315 coaching vehicles will be built, including four sleeping cars, ten restaurant and buffet cars, one complete tourist train set and spares, orders for which have already been placed, as recorded in our Contracts and Tenders section of the December 21, 1934, issue, and four train sets, each of eight coaches, for the Great Eastern suburban service.

Approximately 5,000 goods wagons and brake vans are to be built, including 1,580 vacuum-fitted open 12-ton and 2,200 vacuum-fitted covered 12-ton wagons. Other special types of wagons included in the programme comprise 75 20-ton wagons for the conveyance of tubes, and 500 fish wagons. Small covered containers totalling 300 are to be built, together with 320 flat wagons. The programme also includes the provision of 100 all-steel, all-welded 20-ton wagons for the conveyance of locomotive coal, and the placing of an order for these is recorded in our Contracts and Tenders section this week. The renewal of 436 miles of permanent way and 37 bridges, and the cleaning and painting of a number of stations is also provided for, and special attention will be paid to the improvement of the general appearance of the stations. To this end, at certain of the more important places, special colour schemes will take the place of the usual standard method of treatment.

"STEPHENSON" ON VIEW AT WATERLOO.—On January 8, the first of the converted Baltic tank locomotives of the Southern Railway was on view at Waterloo station between 11 a.m. and 4 p.m. This locomotive, which is now of the 4-6-0 tender type—and was illustrated and described in THE RAILWAY GAZETTE of December 7 last—though it has naturally lost the symmetry of its original form, is a handsome engine and compares favourably in appearance with the "King Arthur" and "Lord Nelson" designs. Large numbers of enthusiasts were attracted to its exhibition, and the Southern Railway's lecturer-driver-showman was kept continuously busy in delivering his short lecture to batches of visitors. It was remarkable how many of these were accommodated at a time in the cab and on a plank "gallery" erected on the tender, so that the audience might be as large as possible for each lecture. Mr. Maunsell is to be congratulated upon the success, in so far as outward appearance is concerned, of this conversion, and, judging by the excellence of the work these engines carried out on the exacting London-Brighton schedules prior to conversion, we have little doubt that their performance as converted will be in keeping with their appearance. They have, moreover, the added advantage of ubiquity, thanks to enhanced coal and water capacity, still further to widen their sphere of usefulness.

NOTES AND NEWS

United Kingdom Railway Officers' & Servants' Association.—Sir Edward W. M. Grigg, K.C.M.G., K.C.V.O., D.S.O., M.P., has consented to preside at the 74th anniversary festival in aid of the funds of this association, which is to be held at the Trocadero, London, on Friday, March 22.

Railway Negotiating Machinery.—Discussions on the question of machinery of negotiation for railway staff were resumed on January 8 between the representatives of the railway companies and representatives of the National Union of Railwaymen, the Associated Society of Locomotive Engineers and Firemen and the Railway Clerks Association. A further meeting will be held on Wednesday, January 16.

London Transport Wages.—The claim of 15,000 workers on London Transport railways for full restoration of the 5 per cent. cut in wages was discussed on January 8 and 9 between representatives of the Transport Board and the three railway unions. The Board had previously restored 2½ per cent., and on January 9 it was agreed that as and from the first full pay period after June 1, all percentage deductions from earnings shall cease.

Southern Railway Bill.—In the Southern Railway Bill for the 1935 Session, power is being sought to raise £7,500,000 after taking into account any premiums or discounts obtained or allowed on the issue of any stock. It is proposed to exercise these powers by the creation and issue of ordinary stock or new preference stock (including new guaranteed preference stock), by borrowing on mortgage of the undertaking, or by the creation and issue of debenture stock.

Railway Air Services Speed-up.—As from January 7, Railway Air Services accelerated the schedules on the trunk route between London, Liverpool, Belfast, and Glasgow. The flying time between Croydon and Belfast was reduced from 3¼ hours to 2¾ hours, and between Croydon and Glasgow from 4 hours 40 minutes to 4 hours, in each direction. This acceleration has been found to be possible, consistent with reliable time-keeping, as the result of experience which has been gained under both summer and winter conditions.

European Wagon Building Cartel.—We are informed by L'Association Internationale des Constructeurs de Matériel Roulant, to which we referred in a news paragraph on page 35 of last week's issue, that the founder members of the organisation as newly constituted by statutes adopted on November 23 last are prominent rolling stock manufacturers of Austria, Belgium, France, Hungary, Poland, and Switzerland. Provision is made for the admission of manufacturers from other European countries and from the U.S.A., so that allotment of proportionate exports is not at the moment capable of definite adjustment.

Hull Level Crossing Abolition Deferred.—Hull City Council decided on January 3 to defer for twelve months consideration of a £1,400,000 scheme to abolish all railway level crossings in the city.

Christmas Decorations at Charing Cross.—The illuminated Christmas decorations in the booking hall at Charing Cross station, London Passenger Transport Board, which we illustrated on page 18 of last week's issue, were carried out with Osram decoration lamps supplied by the General Electric Co. Ltd., to which company we were indebted for the photograph we reproduced.

L.N.E.R. Superintendent to Report on Palestine Railways.—At the request of the Palestine Government, Mr. C. M. Jenkin Jones, Superintendent, London & North Eastern Railway, York, is to advise and report on matters concerning the Palestine Railways. The L.N.E.R. having arranged to release Mr. Jenkin Jones from his ordinary duties for a period of three months, he and Mrs. Jenkin Jones left York for Palestine yesterday (January 10), as briefly recorded in our Personal column.

Grand Trunk Railway Stockholders.—A petition for special leave to appeal against the decision of the Supreme Court of Canada regarding the position of the holders of preference and consolidated stocks of the Grand Trunk Railway Company has been presented to the Judicial Committee of the Privy Council by Mr. Lovibond, acting on behalf of the stockholders. Last June, Mr. Justice Middleton in Ontario granted an order admitting the right of Mr. Lovibond to appeal to the Judicial Committee of the Privy Council, but this was reversed by the Supreme Court.

New Numbering Schemes for Locomotive Depots, L.M.S.R.—A new scheme of numbering for motive power depots is being brought into operation by the L.M.S.R. Hitherto, separate series of shed numbers (which, among other uses, are carried on the smokebox doors of locomotives in order to identify the depot to which the engine is allocated) have been used on the Western, Midland and Central Divisions, respectively, while there has been no special system in use on the Northern Division. The Northern Division is now included in the new series of shed numbers, which have been allotted to all depots throughout the L.M.S. system without regard to the preservation of existing numbers in the case of the Western, Midland and Central Divisions. Of the new shed numbers adopted from 1 to 29 inclusive are retained for the main or parent depots of each district, while subordinate depots have the number of the parent depot in conjunction with an identifying letter.

Railway Photography Exhibition.—An exhibition of railway photographs arranged by Mr. J. H. L. Adams is now being held at the Ilford Galleries, 101, High Holborn. The closing date is February 16. There are 74 photographs of locomotives and trains, old and new, exhibited, some of which will be familiar as having appeared in THE RAILWAY GAZETTE.

L.N.E.R. London City District Annual Dinner and Dance.—The staff of the London City District of the L.N.E.R. held a highly successful dinner and dance in the Hamilton Hall, Liverpool Street Hotel, on Friday, January 4, when over 300 sat down to dinner under the chairmanship of Mr. Percy Syder. Mr. F. C. Robbins, goods agent, King's Cross, occupied the vice-chair. Afterwards there was a well-attended whist drive and a very enjoyable dance until midnight.

Events in 1935.—The Travel and Industrial Development Association of Great Britain and Ireland has just issued its sixth annual calendar of events. Made to fit the vest pocket, this booklet provides an excellent guide to all of importance that is to happen in the British Isles this year. In addition, there is an information section designed to be particularly useful to the visitor from overseas. The calendar has been printed in English, Spanish, French and German, and its circulation extends through 56 countries.

A Symposium on Welding.—A symposium of papers on the welding of iron and steel has been arranged by the Iron and Steel Institute to be read in the lecture theatre of the Institution of Civil Engineers on May 2 and 3 next. The aspects of the subject to be dealt with have been divided into five main groups, as follows: Group 1, present-day practice and problems of welding in the engineering industries; Group 2, welding practice and technique; Group 3, the metallurgy of welding; Group 4, specification, inspection, testing and safety aspects of welding; Group 5, current research projects in welding. It is intended to publish the papers delivered under the above headings, together with the discussions thereupon, in a bound volume. A criticial summary of the proceedings and the suggestions arising therefrom will be prepared when the symposium terminates. Authors from countries abroad have been invited to contribute, as well as those in Great Britain. The symposium is being organised with the co-operation of thirteen other technical societies, in view of the national importance of the subject and the desirability of co-ordinating research so as to avoid overlapping. The possibility of a national scheme for research in welding

is also being considered. Further information may be had from the Secretary, the Iron and Steel Institute, 28, Victoria Street, S.W.1. The committee appointed by the institute to make the arrangements for the symposium and to collaborate with the other societies involved is as follows :—

Sir Harold Carpenter, F.R.S. (Chairman); Dr. H. J. Gough, M.B.E., F.R.S., M.I.Mech.E.; Dr. W. H. Hatfield; Mr. James Henderson; Dr. A. McCance; Dr. T. Swinden; Mr. B. Talbot, M.I.Mech.E.

Railway Accidents in Russia.—Last Sunday an express from Leningrad to Moscow collided with another train standing near Porbelo station, about 136 miles from Leningrad. It is reported that 23 persons were killed. Another accident in which six people were killed and 23 injured is reported to have occurred at Rostov-on-the-Don.

Russian 14-Coupled Locomotive.—The first of two 14-coupled locomotives is now running trials on the railways of the U.S.S.R., and has developed over 3,100 rail h.p. The design was evolved specially for fast coal traffic on the new Moscow-Donbass line, but the preliminary design of 2-14-4 has been changed to 4-14-4. These locomotives have been built at Lugansk, but much of the preliminary work was done by Krupp.

New P.L.M. Folders.—Two very artistic folders reach us from 179, Piccadilly, S.W.1—the London office of the P.L.M. Railway. One describes the fascinating winter sports in the French Alps, and the other deals with sightseeing in such picturesque regions as Morocco, Algeria, and Tunisia. Both are beautifully illustrated, and the sports pictures are especially charming. Copies of the folders may be obtained gratis on application to the London office aforesaid.

Japanese Super Express.—As a result of the success of the Japanese-built streamlined Pacific locomotive and carriages of the Asia Express in Manchuria, the Japanese Ministry of Railways is considering proposals to introduce similar trains between Toyko and Shimonoseki, which would reduce the present time of 19¾ hr. to 14 hr. for the 704 miles. As the route would need re-aligning for speeds of 75 m.p.h., it is anticipated that at least two years must elapse before such a train could be put into service.

Diagram of the "Cock o' the North."—The L.N.E.R. has prepared for publication a diagram drawing, by J. H. Clark, of the new 2-8-2 express passenger locomotive, the *Cock o' the North*. The drawing, the execution of which is excellent, is similar to that issued in September, 1933, of the L.N.E.R. 4-6-4 locomotive, No. 10000. Where necessary, the sides of the locomotive are shown as having been cut away to illustrate the internal constructional details. Copies of the drawing, 20 in. by 6 in. (actual size), will shortly be on sale at all the company's stations and bookstalls, price one shilling.

A Touring Camping Coach.—A novel extension of the popular camping coach facility is announced by the L.N.E.R. for the holiday season of this year. A vehicle with sleeping and living accommodation for six persons, or seven if necessary, will make weekly tours in the Yorkshire dales and moors. A fixed schedule has been planned, giving a departure from York on Saturday afternoons and calling in the course of the week at Pateley Bridge, Aysgarth, Barnard Castle, Glaisdale, and Coxwold. The charge for a week's tour will be from £15 to £20, excluding provisions, according to the season.

New L.M.S. Southend Line Station.—During the first fortnight it has been open for traffic over 13,000 passengers have used the new Upminster Bridge station on the Barking–Upminster electrified section of the L.M.S. London, Tilbury and Southend line. The station, which serves a growing residential district, was opened shortly before Christmas. Traffic on this side of London is developing so rapidly that the L.M.S.R. recently placed a contract (briefly recorded on page 31 of our January 4 issue) for another new station, to be called Elm Park, on the same line, between Dagenham and Hornchurch.

Pioneer Work by British Engineers.—Sir Clement Hindley will preside over a meeting of the Royal Empire Society at the Hotel Victoria on Tuesday, January 15, at 8.30 p.m., when addresses dealing with the pioneer work of British engineers overseas will be given by Mr. Ralph Freeman, who designed the Sydney Bridge, Mr. Julian Tritton, who will give a description of some of the more famous harbours and bridges of the Empire, Brig.-General F. D. Hammond, who will speak on railway development in the Colonies and Colonel Pollard-Lowsley on Irrigation in India. Admission will be by ticket, obtainable free, from the Royal Empire Society, 17, Carlton House Terrace, S.W.1.

The First Steel from Corby.—The making of the first heat of steel in the basic Bessemer department of the new Corby works of Stewards and Lloyds Limited, Northamptonshire, on December 27 last, marked an important stage in the history of the British iron and steel industry. The revival of the basic Bessemer process in this country will permit the production of steel and tubes direct from native ores, causing the absorption of British workmen into the various complementary activities such as mining, rolling, and so on. Representatives of Stewarts and Lloyds Limited and of H. A. Brassert & Co. Ltd., consulting engineers for the erection and operation of the Corby works, watched the blowing of a high-grade steel, suitable for the manufacture of tubes, in the first of the three converters. The molten metal was poured in direct from No. 1 blast furnace. With this achievement the Corby works have entered upon the stage of tuning in preparatory to full commercial production, which should be reached within a few months. The blast furnaces, ore-treating plant, coke ovens, by-product plant, rolling mills, and tube works started operations earlier in 1934.

The Week's Road Accidents.—The Ministry of Transport return for the week ended January 5 of persons killed or injured in road accidents is as follows :—

	Killed	Deaths resulting from previous accidents	Injured
England	105 (114)	25 (42)	3,277 (3,365)
Wales ...	4 (10)	— (3)	135 (139)
Scotland	18 (13)	6 (5)	357 (356)
	127 (137)	31 (50)	3,769 (3,860)

The total fatalities for the week were, therefore, 158, as compared with 187 for the previous week.

Forthcoming Events

Jan. 11 (*Fri.*).—Institute of Transport (Leeds), at Town Hall, 6.30 p.m. "The Development of the Wheel," by Mr. F. Fellowes.
Institution of Mechanical Engineers, Storey's Gate, London, S.W.1, 7 p.m. "Automatic Railway Signalling," by Mr. E. E. Pierce.
Railway Students' Association (Edinburgh), at Goold Hall, St. Andrew Square, 7.30 p.m. "The Future of Railways," by Mr. E. J. H. Lemon.
Retired Railway Officers' Society, at Abercorn Rooms, Liverpool Street, London, E.C.2, 2.30 p.m. Ladies' Afternoon.

Jan. 14 (*Mon.*).—Stephenson Locomotive Society, at King's Cross Station, L.N.E.R., 6.30 p.m. "The Locomotive at Work," by Mr. B. Adkinson.
Permanent Way Institution (Brighton), at Lecture Room, New England Street, 7 p.m. "Methods of Relaying," by Mr. T. Bater. "Sleeper Packing," by Mr. Whiting.

Jan. 15 (*Tues.*).—Federation of Railway Lecture and Debating Societies (N.E. Area), at North Road Inst., Darlington, 7.20 p.m. Paper by Sir John Maxwell, C.M.G.
Institute of Transport (London), at Inst. of Electrical Engineers, Savoy Place, W.C.2, 6 p.m. "Steel Rolling Stock (Passenger) for Railways," by Mr. C. E. R. Sherrington.
Royal Empire Society, at Hotel Victoria, Northumberland Avenue, London, W.C.2, 8.30 p.m. "The Sydney Bridge," by Mr. R. Freeman. "Ports, Bridges and Railways in the East," by Mr. J. Tritton. "Railway Development in the Colonies," by Brig.-General F. D. Hammond, C.B.E., D.S.O. "Irrigation in India," by Colonel H. Pollard-Lowsley, C.M.G., C.I.E., D.S.O.

Jan. 16 (*Wed.*).—Institute of Transport (Manchester-Liverpool Graduate), at Exchange Station Hotel, Liverpool, 6.30 p.m. "Improved and Little-known Transport Facilities," by Mr. S. Pimblett.
Institution of Railway Signal Engineers, at Inst. of Electrical Engineers, Savoy Place, London, W.C.2, 6 p.m. "Some Applications of Rectifiers to Railway Signalling," by Mr. L. H. Peter.
Engineers' Study Group on Economics, at Denison House, 296, Vauxhall Bridge Road, S.W. "The Engineer and Technical Worker and the Socialist State," by Major C. R. Attlee, M.P.

Jan. 17 (*Thurs.*).—Railway Students' Association, at London School of Economics, Houghton Street, W.C.2. "Lighterage in Relationship to Rail Transport," by Mr. C. R. East.

Jan. 18 (*Fri.*).—Railway Club, 57, Fetter Lane, London, E.C.4, 7.30 p.m. "The Eastern Section of the Great Central Railway," by Mr. E. B. Woodruffe-Peacock.

British and Irish Traffic Returns

GREAT BRITAIN	Totals for 1st Week			Totals to Date		
	1935	1934	Inc. or Dec.	1935	1934	Inc. or Dec.
L.M.S.R. (6,940¼ mls.)	£	£	£	£	£	£
Passenger-train traffic...	363,000	341,000	+ 22,000	363,000	341,000	+ 22,000
Merchandise, &c. ...	369,000	381,000	− 12,000	369,000	381,000	− 12,000
Coal and coke ...	222,000	241,000	− 19,000	222,000	241,000	− 19,000
Goods-train traffic ...	591,000	622,000	− 31,000	591,000	622,000	− 31,000
Total receipts	954,000	963,000	− 9,000	954,000	963,000	− 9,000
L.N.E.R. (6,339 mls.)						
Passenger-train traffic...	260,000	240,000	+ 20,000	260,000	240,000	+ 20,000
Merchandise, &c. ...	277,000	257,000	+ 20,000	277,000	257,000	+ 20,000
Coal and coke ...	203,000	205,000	− 2,000	203,000	205,000	− 2,000
Goods-train traffic ...	480,000	462,000	+ 18,000	480,000	462,000	+ 18,000
Total receipts	740,000	702,000	+ 38,000	740,000	702,000	+ 38,000
G.W.R. (3,750¾ mls.)						
Passenger-train traffic...	160,000	156,000	+ 4,000	160,000	156,000	+ 4,000
Merchandise, &c. ...	164,000	163,000	+ 1,000	164,000	163,000	+ 1,000
Coal and coke ...	98,000	109,000	− 11,000	98,000	109,000	− 11,000
Goods-train traffic ...	262,000	272,000	− 10,000	262,000	272,000	− 10,000
Total receipts	422,000	428,000	− 6,000	422,000	428,000	− 6,000
S.R. (2,172 mls.)						
Passenger-train traffic...	235,000	226,000	+ 9,000	235,000	226,000	+ 9,000
Merchandise, &c. ...	49,500	48,500	+ 1,000	49,500	48,500	+ 1,000
Coal and coke ...	30,500	29,500	+ 1,000	30,500	29,500	+ 1,000
Goods-train traffic ...	80,000	78,000	+ 2,000	80,000	78,000	+ 2,000
Total receipts	315,000	304,000	+ 11,000	315,000	304,000	+ 11,000
Liverpool Overhead ... (6½ mls.)	1,094	1,096	− 2	1,094	1,096	− 2
Mersey (4½ mls.) ...	4,578	4,751	− 173	4,578	4,751	− 173
*London Passenger Transport Board ...	551,500	524,200	+ 27,300	14,410,700	14,102,600	+ 308,100
IRELAND						
Belfast & C.D. pass. (80 mls.)	2,224	2,075	+ 149	2,224	2,075	+ 149
,, ,, goods	540	530	+ 10	540	530	+ 10
,, ,, total	2,764	2,605	+ 159	2,764	2,605	+ 159
Great Northern pass. (562 mls.)	8,400	7,700	+ 700	8,400	7,700	+ 700
,, ,, goods	7,350	7,000	+ 350	7,350	7,000	+ 350
,, ,, total	15,750	14,700	+ 1,050	15,750	14,700	+ 1,050
Great Southern pass. (2,158 mls.)	20,396	19,650	+ 746	20,396	19,650	+ 746
,, ,, goods	39,458	26,897	+ 12,561	39,458	26,897	+ 12,561
,, ,, total	59,854	46,547	+ 13,307	59,854	46,547	+ 13,307

* 27th week, the receipts for which include those undertakings not absorbed by the L.P.T.B. in the corresponding period last year; last year's figures are, however, adjusted for comparative purposes

The Success of Penny-a-mile Fares

In the course of an interesting paper on railway statistics, presented to the Manchester Statistical Society on Wednesday, Mr. Ashton Davies, Chief Commercial Manager, L.M.S.R., spoke of the deliberations which preceded the introduction in May, 1933, of penny-a-mile tickets for return journeys. Statistics showed that if ordinary fares were to be reduced from 1½d. to 1d. per mile, the railway companies must be prepared—deliberately—to "cast bread upon the waters" to the extent of £1,500,000 in the case of the L.M.S.R. alone. Success was undoubted, because the reduction in fares and elimination of restrictions had created a marked stimulus to travel, and the railways had finished up on the right side.

Cost of service did not march in step with rise or fall in volume of traffic, by reason of the large amount—estimated as high as 60 per cent.—of fixed or non-variable expenditure. All this resulted in a greater expenditure to earn £1 of gross receipts in times of depression, and less in times of business activity. He submitted the appended table of receipts and operating revenue. Two interesting features in the figures were that the loss of £11,500,000 of receipts in 1926 through the general strike sent the operating ratio to the abnormal figure of 90·60; and that although gross receipts in 1931 and subsequent years were less than in the strike year, the operating ratios had been much better. This was because the attrition was gradual and the railways had been able to adjust their position by economy and scientific cost reduction.

L.M.S.R. Receipts and Operating Ratio

Year	Gross Railway Receipts £	Operating ratio %
1924 ...	78,878,530	81·45
1925 ...	77,308,424	81·95
1926 ...	65,824,671	90·60
1927 ...	77,816,774	78·98
1928 ...	73,870,072	79·79
1929 ...	73,195,264	79·45
1930 ...	68,241,425	82·17
1931 ...	63,223,399	81·25
1932 ...	58,507,261	84·09
1933 ...	58,185,439	82·88

British and Irish Railways Stocks and Shares

Stocks	Highest 1934	Lowest 1934	Prices Jan. 9, 1935	Prices Rise/Fall
G.W.R.				
Cons. Ord. ...	66½	48½	51½	+½
5% Con. Prefce. ...	118	109	118	−½
5% Red.Pref.(1950)	115	107	115½	+1
4% Deb.	117	105	115½	—
4½% Deb.... ...	119	109	117½	+1
4½% Deb.... ...	129½	115¼	127½	—
5% Deb.	135	126¼	134½	+1
2½% Deb.... ...	75	64	76½	—
5% Rt. Charge ...	134 7/16	123¼	133½	—
5% Cons. Guar. ...	132¾	121¾	133	+½
L.M.S.R.				
Ord.	30½	19½	21	—
4% Prefce. (1923)	64¼	41	50	+½
4% Prefce. ...	87	69½	87	+½
5% Red. Prf. (1955)	107	92½	105½	+½
4% Deb.	114⅛	100⅛	109	—
5% Red.Deb.(1952)	118 11/16	111¼	118½	+1
4% Guar.	106½	96¾	105	—
L.N.E.R.				
5% Pref. Ord. ...	24¾	13½	14¾	+¼
Def. Ord.	11½	6⅞	7¼	—
4% First Prefce. ...	76	59½	73½	—
4% Second Prefce.	47	25½	30	—
5% Red.Pref.(1955)	94½	80	91½	—
4% First Guar. ...	104	92	103	+½
4% Second Guar.	97⅞	86½	97½	+1
3% Deb.	90	74½	85½	+½
4% Deb.	114	99¼	109	+½
5% Red.Deb.(1947)	117	108	117	—
4½% Sinking Fund Red. Deb.	111¼	105¼	110	+½
SOUTHERN				
Pref. Ord.... ...	90	63⅛	79	—
Def. Ord.	32⅝	19	22	—
5% Prefce. ...	118 5/16	107½	119	+½
5% Red.Pref.(1964)	115¾	107½	114½	—
5% Guar. Prefce.	132	120¾	131½	—
5% Red.Guar.Pref. (1957)	119½	113	119	—
4% Deb.	116½	103¼	115½	+½
5% Deb.	134	124 13/16	134½	+2
4% Red. Deb. 1962–67	113 11/16	105 9/16	113	+1
BELFAST & C.D.				
Ord.	6	5	5¼	—
FORTH BRIDGE				
4% Deb.	110	100	109½	—
4% Guar. ...	110	100	108½	—
G. NORTHERN (IRELAND)				
Ord.	9¾	4 15/16	7	+1
G. SOUTHERN (IRELAND)				
Ord.	25	12½	14½	−½
Prefce.	21½	13 15/16	27½	+1 11/16
Guar.	48	39	58	+11
Deb.	67	59	73	+6½
L.P.T.B.				
4½% "A" ...	126	115	126½	+2
5% "A"	135½	124½	136½	+1
4½% "T.F.A." ...	113½	107½	112	—
5% "B"	131¾	118	128½	+2
"C"	97	73	98	−2
MERSEY				
Ord.	15¼	7	10	—
4% Perp. Deb. ...	93½	82½	93½*	−1½
3% Perp. Deb. ...	66½	61½	67½*	−1
3% Perp. Prefce....	54	44½	48½	—

* ex dividend

CONTRACTS AND TENDERS

D. Wickham & Co. Ltd. has received an order from the Egyptian State Railways Administration for three petrol-driven saloon inspection railcars at a total price of £1,380, f.o.b. London.

All-Welded Wagons for L.N.E.R.

The Metropolitan-Cammell Carriage & Wagon Co. Ltd. has received an order from the L.N.E.R. for 100 all-steel, all-welded 20-ton wagons for the transport of locomotive coal. These wagons, which are to be fitted with Taylor Bros. solid-forged and rolled steel wheels, are of the special registered design evolved by the Metropolitan-Cammell Carriage & Wagon Co. Ltd. and described and illustrated in our issue of October 26 last.

Taylor Bros. & Co. Ltd. has received an order from the Buenos Ayres Great Southern Railway for 365 steel locomotive tyres.

H. J. Skelton & Co. Ltd. has received an order from the Egyptian State Railways Administration for a quantity of mild steel joists at a total price of £2,463 10s. 10d., free delivery (Ref. No. E.S.R. 1.164).

The D.P. Battery Co. Ltd. has received an order from the British Electrical & Allied Industries Research Association for the supply and installation of a 230-volt battery, capable of discharging at 784 amperes, at the Electrical Research Association's Laboratory, Perivale, Middlesex.

The English Electric Co. Ltd. has been awarded the contract for the supply, erection and operation of the diesel generating plant which will provide the complete power requirements for the British pavilion at the International Exhibition, Brussels, 1935.

Les Ateliers Metallurgiques, Nivelles, has received an order through W. H. Martin Limited from the Great Indian Peninsula Railway for 300 cast steel locomotive coupled-wheel axleboxes at a price of Rs. 37-8 each, free delivery.

Leyland Motors Limited has received the following orders from railway-associated road transport operators :—

Sheffield Corporation : 21 Oil-engined Tiger and Titan gearless buses.

Greenock Motor Services Company : Seven oil-engined Lions.

Southdown Motor Services Limited : 27 Oil-engined Titans.

Western S.M.T. Co. Ltd. : 50 Oil-engined Tigers.

Central S.M.T. Co. Ltd. : 22 Oil-engined Tigers and eight oil-engined Titans.

W. Alexander & Sons Ltd. : Six oil-engined Titans.

The Tilley Lamp Company has received further orders from the L.M.S.R. for about 300 AL.9-type Tilley lamps for use in tunnels.

The Tilley Lamp Company has also received an order from the Bombay, Baroda & Central India Railway for 24 Tilley floodlight projectors.

The Associated Equipment Co. Ltd. has received repeat orders from the London Passenger Transport Board for 200 oil-engined Regent double-decked passenger vehicles ; from the Sheffield Transport Department for seven oil-engined Regent double-decked passenger vehicles ; and from the Scottish Motor Traction Co. Ltd. for 40 oil-engined Regal single-decked passenger vehicles.

L.N.E.R. 1935 New Rolling Stock and Works Programme

The L.N.E.R. 1935 programme of which the details are published on page 62 of this issue, while editorial comment is also made on page 37, provides for 88 locomotives, of which 39 are J39 class 0-6-0 freight engines ; 35 are K3 class three-cylinder 2-6-0 mixed-traffic engines and 14 are of a type not finally decided upon at the moment, but specially intended for heavy long distance work. The 315 coaching vehicles include four sleeping cars, ten restaurant and buffet cars, one tourist train set and spare vehicles for these sets (orders for this stock were recorded in this section in our December 21, 1934, issue) and four eight-coach train sets for Great Eastern suburban services. The total of approximately 5,000 goods wagons and brake vans provided for includes 3,780 12-ton vacuum-fitted wagons, 75 20-ton wagons for tube conveyance, 500 fish wagons, 320 flat wagons and 100 all-steel all-welded 20-ton locomotive coal wagons, the order for which is recorded elsewhere on this page. The containers are to consist of 300 of the small covered type. Provision is also made among other works for the renewal of 436 miles of permanent way, reconstruction of 37 bridges and the cleaning and painting of a number of stations. As in the case of the L.M.S.R. programme, which with that of the G.W.R. was announced in our issue of last week, orders for some of the locomotives and rolling stock will probably be placed with contractors, while a good proportion of spare parts and details with quantities of raw materials will also be ordered outside.

L.N.E.R. Road Vehicle Orders

The L.N.E.R. has placed the following orders for road transport vehicles :—

Stewart & Ardern Limited : 18 Morris-Commercial 10-cwt. parcels vans.

Unwins Limited : Six 1-ton Ford parcels vans ; one 30-cwt. Ford light van ; and eight 2-ton Fordson light vans.

John I. Thornycroft & Co. Ltd. : Seven 1½-ton heavy duty vehicles ; and five 2-ton heavy duty vehicles.

Scammell Lorries Limited : 46 3-ton mechanical horses ; 14 6-ton mechanical horses ; 36 3-ton mechanical horse trailers ; and 50 6-ton mechanical horse trailers.

Cranes (Dereham) Limited : 51 3-ton mechanical horse trailers.

R. A. Dyson & Co. Ltd. : Six 3-ton mechanical horse trailers ; one 5-ton four-wheeled trailer ; and one 6-ton four-wheeled trailer.

Harrow Industrial Co. Ltd. : Two 3-ton four-wheeled telescopic pole-carrying trailers and two 6-ton four-wheeled telescopic pole carrying trailers.

Norris Henty & Gardners Limited has received an order from the Argentine North Eastern Railway for one 30-kW. electric generating set and accessories.

Craven's Railway Carriage & Wagon Co. Ltd. has received an order from the United Steel Cos. Ltd. (Workington Iron & Steel Branch) for six 50-ton all-steel, double-bogie, pig-iron cars.

Craven's Railway Carriage & Wagon Co. Ltd. has also received an order from the Shireoaks Colliery Co. Ltd. for 50 12-ton coal wagons.

Henschel & Sohn A.G., Fried Krupp, and Maschinenfabrik Esslingen have jointly received an order for 25 locomotives for the Chilean State Railways, under the German-Chilean " saltpetre agreement " of 1934, states the Berlin correspondent of *The Times*. Part of the proceeds of the sale of Chilean saltpetre in Germany was to be devoted to the satisfaction of German claims in Chile and part to payment for German exports into Chile under this agreement.

Locomotive Boiler Orders

The Bombay, Baroda & Central India Railway has placed orders for eight locomotive boilers divided as follow :—Nasmyth, Wilson & Co. Ltd. : Three boilers for superheated D.1 class engines ; North British Locomotive Co. Ltd. : Three boilers for superheated H. class engines ; and Robt. Stephenson & Co. Ltd. : Two boilers for saturated F.G. class engines.

Beyer, Peacock & Co. Ltd. has received an order from the Peruvian Corporation for one boiler for a 2-8-2 + 2-8-2 Beyer-Garratt locomotive.

J. Baker & Bessemer Limited has received an order for 50 carriage axles for the Piræus Athens Peloponnesus Railway.

The Agent, North Western Railway of India, Lahore, invites tenders, receivable by February 11, for 700 cast-steel axle-box bodies.

Guest, Keen & Nettlefolds Limited has received an order from the Argentine North Eastern Railway for 70,000 steel fishbolts and nuts.

The Controller of Stores, Jodhpur Railway, Jodhpur, invites tenders for 100 I.R.S. metre-gauge type MC. four wheeled covered wagons. Tenders for wheels and axles and vacuum-brake equipment may be submitted separately.

The Chief Controller of Stores, Indian Stores Department (Miscellaneous Section), New Delhi, invites tenders, receivable by January 24, for wood, brass, and iron screws required during the period May 16, 1935, to May 15, 1936, for the E.I., E.B., N.W., and G.I.P. Railways.

The Chief Controller of Stores, Indian Stores Department (Engineering Section), New Delhi, invites tenders, receivable on January 28, for one 80-ton overhead travelling crane with two 40-ton crabs for Jamalpur locomotive shops, East Indian Railway.

The Bombay, Baroda & Central India Railway invites tenders, receivable on February 6, at the White Mansion, 91, Petty France, Westminster, S.W.1, for one diesel shunting locomotive.

Tenders are also invited by the Bombay, Baroda & Central India Railway, receivable by January 23, for the supply of locomotive tyres.

LEGAL AND OFFICIAL NOTICES

RAILWAY AND OTHER MEETINGS

The nineteenth ordinary general meeting of the Pullman Car Co. Ltd. was held on Monday, December 31, 1934, at the Conference Room, Victoria Station, S.W.1, Sir Follett Holt, K.B.E. (Chairman of the company), presiding.

The Secretary (Mr. E. A. Ashton) read the notice convening the meeting and the auditor's report.

The Chairman, in moving the adoption of the report and accounts, said the collapse in trade had heavily affected the revenue of the railways and all dependent undertakings, but this company had had to suffer in addition further severe losses through the development of the Continental air services, a new form of competition which it had been impossible to meet. During the five-year period of the depression this company's revenue from Continental traffic alone had been reduced by some £200,000. Although with improving times Continental traffic by the railway would doubtless improve on present figures, they must make up their minds that they had lost a substantial number of those passengers they used to serve and who now travelled by air.

On a falling and reduced income they had had to meet during the bad years heavy cash obligations to noteholders and for rolling stock, but now at last through the patient support of the preference shareholders the cash position of the company had been placed on a satisfactory footing, and they were entitled to say that they had come safely through the wood. By the steady repayment year by year of indebtedness and finally by the recent debenture issue of £100,000 they had been able to eliminate a heavy bank overdraft, the final quota of the £250,000 six per cent. note issue which now disappeared, and also to pay a substantial sum towards the acquisition of the 38 new electric cars in use on the Southern Railway.

Indebtedness having been substantially reduced and the cash position placed in order, the resumption of dividend payments to the preference shareholders became possible, and they had decided to recommend the payment to the preference holders of a dividend of 2½ per cent. on account of arrears, and to write down the value of the rolling stock by the amounts mentioned in the report. On account of air competition a return to the revenue of six years ago could not perhaps be expected, but he hoped that they would be able to improve upon the present range of earnings, providing always there was no relapse in the general recovery that was taking place in the prosperity of the country. Last year the total number of pasengers paying supplements in their cars increased by 5·8 per cent., which was a good sign of the turn of the tide. In total the revenue for the year after deducting all interest charges showed a reduction of £3,949 only. Taking into consideration that the catering department was deprived of over £30,000 in receipts which would have accrued if the Scottish services had continued, the result of the year was evidence of the improvement that had taken place in the other services. In the current year from September 30 last there had been no change in receipts of any importance, but the spring and summer should bring increased business. He was satisfied that after a most unpleasant few years the company was not now in financial peril. Knowing the difficulties that had fallen upon the whole railway industry he wished there to register the thanks of the company to the General Manager and the Secretary and to the staff generally for their good efforts to secure the best results possible for the company they faithfully and intelligently served.

The report and accounts were unanimously adopted.

RAILWAY AND OTHER REPORTS

Westinghouse Brake & Saxby Signal Co. Ltd.—Accounts for the year to September 30 show a profit of £23,615 (against a loss of £25,508 for 1932-33) after providing for depreciation, income tax, &c., and charging £22,352 for losses of subsidiary companies. A dividend of 2½ per cent. is recommended (against nil) and £4,193 (against £2,324) is to be carried forward.

Hay's Wharf Limited.—A net profit, after taxation, of £231,623 is shown by the accounts for the year ended June 30. This compares with £225,516 for 1932-33. Preference payments absorb £89,400, and dividends of 4 per cent. and 6 per cent. paid on the ordinary shares during the year together took £100,000. Last year the total ordinary dividend was also 10 per cent. During the year the sale of the company's interest in Hay's Wharf Cartage Company was completed. From the surplus of the purchase price over the written-down book values of the assets disposed of the directors have decided to write off the whole of the goodwills hitherto appearing in the balance sheets of the company and its subsidiaries, and to make a reserve in respect of the excess over par value of the purchase price of the shares of certain of these subsidiaries. The balance remaining after these writings-off amounts to £82,459, which has been added to the general reserve.

Railway Share Market

In the stock and share markets there has been a further turn upward in the quotations for gilt-edged securities of the British Government class, many of which have reached the highest prices touched since they were first created. This pronounced movement is shortening the scope for possible further appreciation so much as to cause some leading brokerage firms to make a cautious reference to the possibility of 1935 seeing the final phase of this upward movement.

One firm in its new year letter specifically draws attention to the scope still offered by home railway first debenture stocks for providing a yield of about a half per cent. more than is to be obtained on British Government securities. It is pointed out that no default in interest payment has ever taken place on any of the debenture stocks of the four grouped railways, and that in the worst years of the depression the amount of net revenue behind, for example, the 4 per cent. first debenture stock of the Southern and the 4 per cent. first debenture stock of the London Midland & Scottish was very much more than is required to meet the yearly interest. Attention is also drawn to the scope for appreciation in the latter company's first preference stock on which 3½ per cent. was paid for 1933 and which is now receiving the full half-year's interest at the rate of 4 per cent. per annum. The yield at present price is about £4 12s. per cent., which is in excess of the yield obtainable on first-grade industrial companies' ordinary shares. London Passenger Transport Board's "C" stock still attracts buyers on the current earnings of 4 per cent. per annum and its title to 6 per cent. when on a full revenue earning basis.

In the Foreign Railway market Entre Rios ordinary stock was raised two points on a little buying. The market in the stock is often a nominal one and the general trend of the market is not reflected in its movement as accurately as in B.A. Great Southern ordinary or B.A. Western ordinary stocks. These remained steady, but there was some weakness shown by Central Argentine ordinary and preference. A good feature in other directions was Nitrate Railways shares, which rose sharply. Indian Railway issues were inclined to harden on the views expressed by Sir Felix Schuster regarding the future financial situation of India under the proposed new legislation.

Traffic Table of Overseas and Foreign Railways Publishing Weekly Returns

	Railways	Miles open 1934-35	Week Ending	Traffics for Week: Total this year	Traffics for Week: Inc. or Dec. compared with 1934	No. of Week	Aggregate Traffics to Date: Totals: This Year	Aggregate Traffics to Date: Totals: Last Year	Aggregate Traffics to Date: Increase or Decrease	Shares or Stock	Prices: Highest 1934	Prices: Lowest 1934	Prices: Jan. 9, 1935	Yield % (See Note)
				£	£		£	£	£					
South & Central America.	Antofagasta (Chili) & Bolivia	830	6.1.35	12,200	+ 2,930	1	7,400	9,270	− 1,870	Ord. Stk.	26 3/4	19	22 1/2	Nil
	Argentine North Eastern	753	5.1.35	6,981	+ 824	27	200,152	242,410	− 42,258	,,	11	6 7/8	9	Nil
	Argentine Transandine	111	—	—	—	—	—	—	—	A. Deb.	52	45	50	8
	Bolivar	174	Dec., 1934	5,700	+ 350	52	71,400	72,700	− 1,300	6 p.c. Db.	10	6 1/2	10	Nil
	Brazil	—	—	—	—	—	—	—	—	Bonds.	135 1/4	107 1/16	13	3 13/16
	Buenos Ayres & Pacific	2,806	5.1.35	63,775	− 8,914	27	1,853,668	2,190,911	− 337,243	Ord. Stk.	16 1/2	8 1/2	9 1/2	Nil
	Buenos Ayres Central	190	16.12.34	$89,500	− $21,100	24	$2,932,300	$2,798,200	+ $134,100	Mt. Db.	23	10	21 1/2	Nil
	Buenos Ayres Gt. Southern	5,085	5.1.35	157,210	+ 4,944	27	3,326,690	4,198,281	− 871,591	Ord. Stk.	35	22	26 1/2	Nil
	Buenos Ayres Western	1,930	5.1.35	39,859	− 6,485	27	1,122,632	1,421,894	− 299,262	,,	27 1/2	18 1/2	23 1/2	Nil
	Central Argentine	3,700	5.1.35	112,755	− 7,626	27	3,093,458	3,662,031	− 568,573	,,	23	13 1/2	15	Nil
	Do.	—	—	—	—	—	—	—	—	Dfd.	14	7	8	Nil
	Cent. Uruguay of M. Video	273	5.1.35	15,330	− 5	27	440,678	435,291	+ 5,387	Ord. Stk.	15 1/2	8	9	Nil
	Do. Eastern Extn.	311	5.1.35	3,638	+ 539	27	91,551	83,276	+ 8,275	—	—	—	—	—
	Do. Northern Extn.	185	5.1.35	2,067	+ 491	27	49,077	46,656	+ 2,421	—	—	—	—	—
	Do. Western Extn.	211	5.1.35	1,524	− 114	27	39,177	39,753	− 576	—	—	—	—	—
	Cordoba Central	1,218	5.1.35	26,200	+ 580	27	802,820	1,028,820	− 226,000	Ord. Inc.	6	3	4	Nil
	Costa Rica	188	Oct., 1934	13,646	− 2,769	13	63,485	81,190	− 17,705	Stk.	30 3/4	23 1/2	30	6 11/16
	Dorada	70	Nov., 1934	10,400	+ 3,000	47	112,800	85,800	+ 27,000	1 Mt. Db.	103	95	102 1/2	5 7/8
	Entre Rios	810	5.1.35	16,922	+ 2,318	27	328,675	361,427	− 32,752	Ord. Stk.	21 1/2	12	14 1/2	Nil
	Great Western of Brazil	1,082	5.1.35	7,700	− 1,300	1	6,600	8,400	− 1,800	Ord. Sh.	7/8	5/8	5/8	Nil
	International of Cl. Amer.	794	Nov., 1934	$365,862	+ $18,171	47	$4,311,914	$4,125,766	+ $186,148	—	—	—	—	—
	Interoceanic of Mexico	—	—	—	—	—	—	—	—	1st Pref.	1/–	1/–	1/2	Nil
	La Guaira & Caracas	22 3/4	Dec., 1934	3,200	− 200	52	42,350	55,670	− 13,320	Stk.	12 5/4	7 5/8	8 1/2	Ni
	Leopoldina	1,918	5.1.35	25,232	+ 9,896	1	20,487	11,520	+ 8,967	Ord. Stk.	14 5/8	7	8	Nil
	Mexican	483	31.12.34	$302,400	− $5,200	26	$5,918,500	$4,992,100	+ $926,400	,,	3 1/4	1 1/2	1 1/2	Nil
	Midland of Uruguay	319	Dec., 1934	13,508	+ 1,966	26	65,833	57,230	+ 8,603	,,	1 1/2	1/2	1 1/2	Nil
	Nitrate	401	31.12.34	13,123	+ 1,235	52	256,066	147,158	+ 108,908	Ord. Sh.	32 9/32	51/–	27 8	Nil
	Paraguay Central	274	5.1.35	4,680	+ 1,620	27	124,970	88,620	+ 36,350	Pr. Li. Stk.	84	67	81 1/2	7 3/8
	Peruvian Corporation	1,059	Dec., 1934	61,978	+ 7,227	26	371,516	329,691	+ 41,825	Pref.	14 1/2	8	9	Nil
	Salvador	100	29.12.34	¢28,500	+ ¢8,110	26	¢331,552	¢370,183	− ¢38,631	Pr. Li. Db.	75	70	70	7 1/8
	San Paulo	153 1/2	30.12.34	33,034	+ 3,582	52	1,534,256	1,576,749	− 42,493	Ord. Stk.	86	67	77	5 5/16
	Taltal	164	Dec., 1934	2,140	− 1,483	26	13,570	12,515	+ 1,055	Ord. Sh.	2 1/8	1 7/16	1 3/4	5 11/16
	United of Havana	1,365	5.1.35	12,516	− 1,860	27	434,143	355,304	+ 78,839	Ord. Stk.	6	2	3	Nil
	Uruguay Northern	73	Dec., 1934	1,528	+ 230	26	7,294	7,383	− 89	Deb. Stk.	6 1/4	3	5 1/2	Nil
Canada.	Canadian National	23,733	21.12.34	617,110	+ 53,659	50	32,103,882	28,959,702	+ 3,144,180	—	—	—	—	—
	Canadian Northern	—	—	—	—	—	—	—	— 4 p.c.	Perp. Dbs.	78 1/4	51 1/2	77	5 5/16
	Grand Trunk	—	—	—	—	—	—	—	—	4 p.c. Gar.	104 1/2	97 1/4	103	3 7/8
	Canadian Pacific	17,018	31.12.34	632,600	+ 48,400	52	25,108,600	22,854,000	+ 2,254,600	Ord. Stk.	185 1/16	111 1/16	13	Nil
India.†	Assam Bengal	1,329	8.12.34	28,762	+ 5,577	36	970,083	846,535	+ 123,548	Ord. Stk.	88 1/2	72	90 1/2	3 5/16
	Barsi Light	202	15.12.34	2,175	− 390	37	101,272	109,292	− 7,020	Ord. Sh.	104 1/2	98 3/4	104 1/2	5 3/4
	Bengal & North Western	2,113	15.12.34	52,297	+ 1,303	11	486,257	507,495	− 21,238	Ord. Stk.	297 1/2	262	293 1/2	5 7/16
	Bengal Dooars & Extension	161	15.12.34	2,854	+ 24	37	110,600	110,360	+ 240	,,	125 1/4	124	125 1/2	5 9/16
	Bengal-Nagpur	3,269	8.12.34	108,150	− 4,351	36	3,934,464	3,660,909	+ 273,555	,,	105 1/2	96	104 1/2	3 13/16
	Bombay, Baroda & Cl. India	3,072	29.12.34	170,925	+ 4,350	39	5,912,850	5,649,000	+ 263,850	,,	115	108 1/2	113 1/2	5 5/16
	Madras & South'n Mahratta	3,230	8.12.34	88,650	− 23,552	36	3,834,791	3,849,535	− 14,744	,,	131	122 3/4	127 1/2	7 7/16
	Rohilkund & Kumaon	572	15.12.34	10,295	+ 1,090	11	92,660	86,172	+ 6,488	,,	263	250	262 1/2	6
	South India	2,526	8.12.34	71,051	− 1,523	36	2,863,524	2,822,586	+ 40,938	,,	119	115	114 1/2	7
Various.	Beira-Umtali	204	Oct., 1934	61,135	+ 11,206	4	61,135	49,929	+ 11,206	—	—	—	—	—
	Bilbao River & Cantabrian	15	Dec., 1934	1,614*	+ 626	52	19,947	18,980	+ 967	—	—	—	—	—
	Egyptian Delta	621	20.12.34	7,312	− 1,992	37	173,077	168,241	+ 4,836	Prf. Sh.	21 5/16	15/4	21/2	4
	Great Southern of Spain	104	29.12.34	2,754	+ 585	52	118,076	116,382	+ 1,694	Inc. Deb.	4	3 1/2	3 1/2	Nil
	Kenya & Uganda	1,625	Nov., 1934	171,375	+ 23,927	47	2,030,212	1,932,689	+ 97,523	—	—	—	—	—
	Manila	—	—	—	—	—	—	—	—	B. Deb.	50	33	48	7 5/16
	Mashonaland	913	Oct., 1934	117,273	+ 22,700	4	117,273	94,573	+ 22,700	1 Mg. Db.	101	91 3/4	101	4 15/16
	Midland of W. Australia	277	Nov., 1934	15,075	+ 2,507	21	71,429	65,112	+ 6,317	Inc. Deb.	100	93	96 1/2	4 1/8
	Nigerian	1,905	24.11.34	76,698	+ 20,296	34	1,089,212	899,753	+ 189,459	—	—	—	—	—
	Rhodesia	1,538	Oct., 1934	189,559	+ 29,458	4	189,559	160,101	+ 29,458	4 p.c. Db.	104 7/8	97 1/2	104 1/2	3 13/16
	South African	13,217	8.12.34	565,608	+ 75,514	36	18,404,196	16,225,572	+ 2,178,624	—	—	—	—	—
	Victorian	6,172	Aug., 1934	740,142	+ 27,143	8	1,433,140	1,380,045	+ 53,095	—	—	—	—	—
	Zafra & Huelva	112	Nov., 1934	11,562	+ 636	47	127,888	123,827	+ 4,061	—	—	—	—	—

NOTE.—Yields are based on the approximate current prices and are within a fraction of 1/16.

* Rebellion. † Receipts are calculated @ 1s. 6d. to the rupee. § ex dividend. Salvador receipts are in currency.

The variation in Sterling value of the Argentine paper peso has lately been so great that the method of converting the sterling weekly receipts at the par rate of exchange has proved misleading, the amount being overestimated. The statements from July 1 onwards are based on the current rate of exchange and not on the par value.

Electric Railway Traction

Current Collection at Speed

CERTAIN difficulties have arisen at one time or another in the collection of current from overhead contact wires when a large output is being developed at high speeds. Although naturally faults are more common with a low-voltage d.c. system, where the amperage to be picked up is great, high-tension a.c. systems have not always given every satisfaction at speeds approaching the hundred mark. For efficient current collection, just as much depends upon the design of the overhead gear as upon that of the collecting device, and in this part of the world experience has indicated that if the normal maximum current to be collected by a pantograph exceeds 500 amp., two contact wires should be provided. Very different has been the development of current collectors in certain parts of North America, where a number of important electrified interurban railways have grown directly from old street and local tramway systems. On these lines the trolley collector still holds sway, and its performance seems almost incredible to engineers who have known nothing but pantographs. On the fast services of the Chicago, North Shore & Milwaukee Railroad, for example, four-car trains scaling about 240 tons are operated at speeds in excess of 75 m.p.h. on the level using direct current at a tension of only 600 volts. On the high-speed sections, a single overhead contact line of 4/0 wire is used, and three trolleys per train are employed; this means that each trolley wheel must collect approximately 500 amp. when running at 75 m.p.h., and probably 600 amp. when accelerating rapidly (which the trains must do to keep time on the fast schedules) between 70 and 80 m.p.h.

Rectifier Motive-Power Units

AMONG the many experiments which are now being made in the sphere of electric traction is that of adapting the mercury arc rectifier for use on locomotives and motor coaches. By this means it is hoped to make use of the favourable characteristics of series-wound direct current traction motors while using high-tension alternating current of any phase or frequency, but similar proposals have been mooted for the incorporation of an inverted rectifier for using a.c. motors with d.c. in the overhead line or conductor rail. Compared with motive-power units on the present normal single-phase systems, a rectifier locomotive has a performance which is independent of variations in the frequency of the supply, and the supply itself may be tapped from the industrial high-frequency network without any ensuing complications. By installing phase and frequency converters, three-phase traction motors may be used in conjunction with single-phase supply, or *vice versa,* but neither the simplicity of the apparatus on the locomotive nor the power factor conditions can compete with rectifier locomotives. The principle of using d.c. traction motors in conjunction with a.c. supply has been tried out for two years under service conditions by the Austrian Federal Railways, but in this case the converting apparatus is of the rotary type. The locomotive fitted has three nose-suspended motors driving five axles through coupling rods, and hauls goods trains up to 1,400 tons in weight. Although in a general way the results have been satisfactory, the improvements have not been sufficient to warrant the construction of further converter units in preference to the standard types with single-phase motors. Experiments are now being carried out in Germany and Switzerland with the object of evolving, as a commercial proposition, rectifier locomotives of various powers, and thus making use of the possible saving in weight and the practicability of incorporating regenerative braking if desired, as well as the advantages enumerated above.

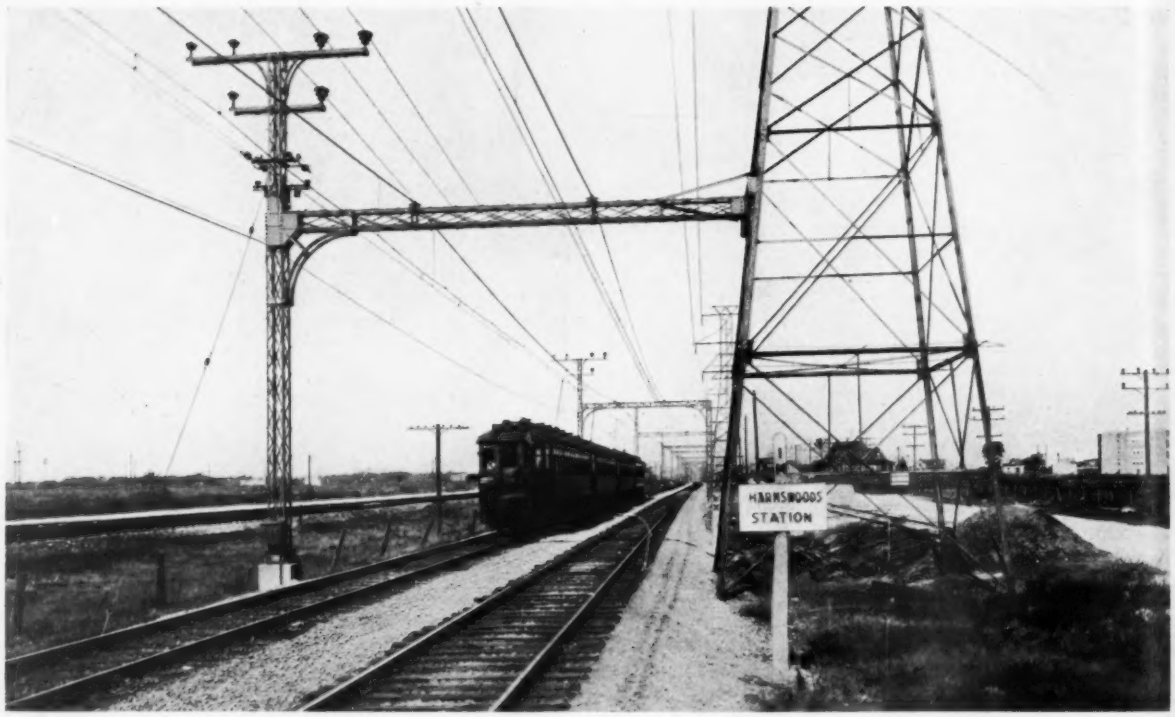
High-Speed Business Trains

SINCE the Marienfelde-Zossen trials of 1904, electric traction has always been considered suitable for high speed work, especially when heavy trains were postulated, for the virtually unlimited power in the contact wire or conductor rail gives the system a decided advantage over steam traction. Normally, a locomotive has been used for electrically-hauled trains operating at high speeds, and although the 130 m.p.h. of the 1904 tests has not since been attained, many records exist of electric locomotives having topped 90 m.p.h. In a general way, multiple-unit trains do not exceed 60 m.p.h., although notable isolated examples exist on the Brighton section of the Southern Railway, where 6 and 12-car trains are known to touch 78-80 m.p.h., and on the Netherlands Railways where 3 to 10-car trains run for miles on end at 60 to 65 m.p.h. Altogether exceptional, however, are the fast interurban services operating out of Chicago on the metals of several companies, more particularly on the Chicago, North Shore & Milwaukee Railroad. End-to-end times of 45-48 m.p.h. are maintained over the 90 miles separating Chicago and Milwaukee inclusive of 5 to 17 stops, but some of the intermediate timings are astounding. For instance, a distance of 74 miles is covered at an average of 60·9 m.p.h. including three halts, and a distance of 15 miles is covered, start-to-start, at 69·4 m.p.h., equivalent to a start-to-stop average of about 70·5 m.p.h. These bookings show the capacity of multiple-unit trains for sustained high speed (some of the passing times are equivalent to an average of 75 m.p.h.), but even better proof of the capabilities of electric traction in the matter of high rates of acceleration no less than in high maximum speed, is the booking of 9 min. start-to-start for the 10·01 miles along the shore of Lake Michigan from Racine to Kenosha, a 67 m.p.h. schedule which is maintained by four trains a day; thirteen trains a day maintain a start-to-start timing of 10 min. between the same two stations, and along with numerous other fast journeys, such as a non-stop run at 56 m.p.h. over a distance of 29 miles, and a 26-mile run at 47·5 m.p.h. *inclusive of eleven intermediate stops,* mark this as the fastest throughout-the-day service in the world, and one in which punctuality is a prime characteristic, for during 1933 over 95 per cent. of the 72,214 passenger trains reached their destination on time.

THE FASTEST ELECTRIC SERVICE IN THE WORLD

American railroad operates intensive interurban service with multiple-unit trains at start-to-stop schedules of 60 to 70 m.p.h.

By RODGER L. SIMONS

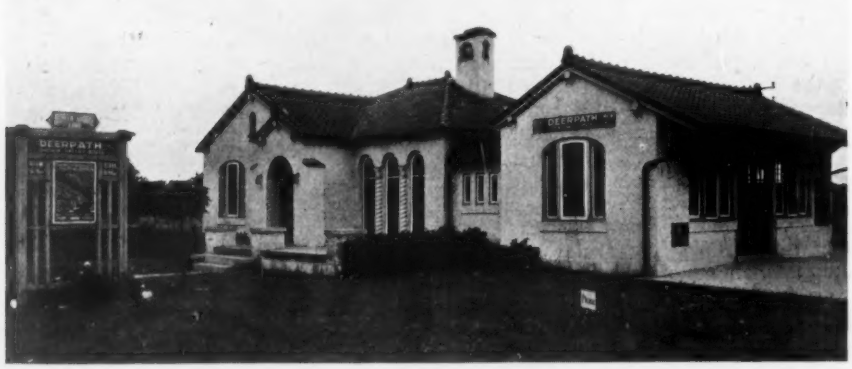


A four-car express electric train running between Chicago and Milwaukee. An industrial high-tension transmission line is erected alongside the railway and some of the pylons form masts for the overhead line

THE Chicago, North Shore & Milwaukee Railroad is an electrified interurban line operating between the middle-western American cities of Chicago and Milwaukee, a distance of approximately 86 miles. It serves the territory between these two cities, skirting the western shore of Lake Michigan at its southern end, and passes through the industrial cities of Racine and Kenosha in Wisconsin and Waukegan in Illinois, as well as a number of smaller cities, chiefly residential in character.

This region is the home of various types of population. The district immediately north of Chicago is almost wholly residential, serving principally as the home of Chicago's business, professional, and salaried groups. The cities farther north are primarily industrial, the whole region being surrounded by a country side devoted to farming, particularly dairying. The total population served by the railroad approaches 4,500,000. Railroad service is performed in the same area by two steam railroads, the Chicago & North Western and the Chicago, Milwaukee, St. Paul & Pacific. There is a well-developed system of modern highways throughout the area on which private automobile operation is heavy, and modern bus and truck lines flourish.

The peculiar contribution to the transportation require-



A typical small station on the Skokie Valley line of the Chicago, North Shore & Milwaukee Railroad

ments of this territory made by the North Shore Line lies in its ability to furnish a fast, frequent, clean, economical, and convenient rail service. Its stations in the terminal cities are situated in the heart of each, a fact which, in combination with its frequency of operation, affords an element of unusual convenience.

Historical Outline

This railroad had its origin in the Bluff City Electric Street Railway Company, incorporated in 1894 with a capital stock of $200,000 and designed to connect the city of Waukegan, Illinois, with Bluff City, now Lake Bluff. In succeeding years the line was extended to the south, and by 1899 franchises were secured as far south as Wilmette, Illinois. The first sizable operation was opened in 1898 from Waukegan to Highland Park, about 15 miles. Three years later a branch line, eight miles long, from Lake Bluff to a point now known as Mundelein, was begun. By 1902 the road extended from Evanston, to Waukegan, Illinois. In 1904 construction was undertaken for the extension of the railroad north of Waukegan to

A section of the main line on the Skokie Valley division showing inexpensive form of overhead construction carrying contact wire and telegraph lines

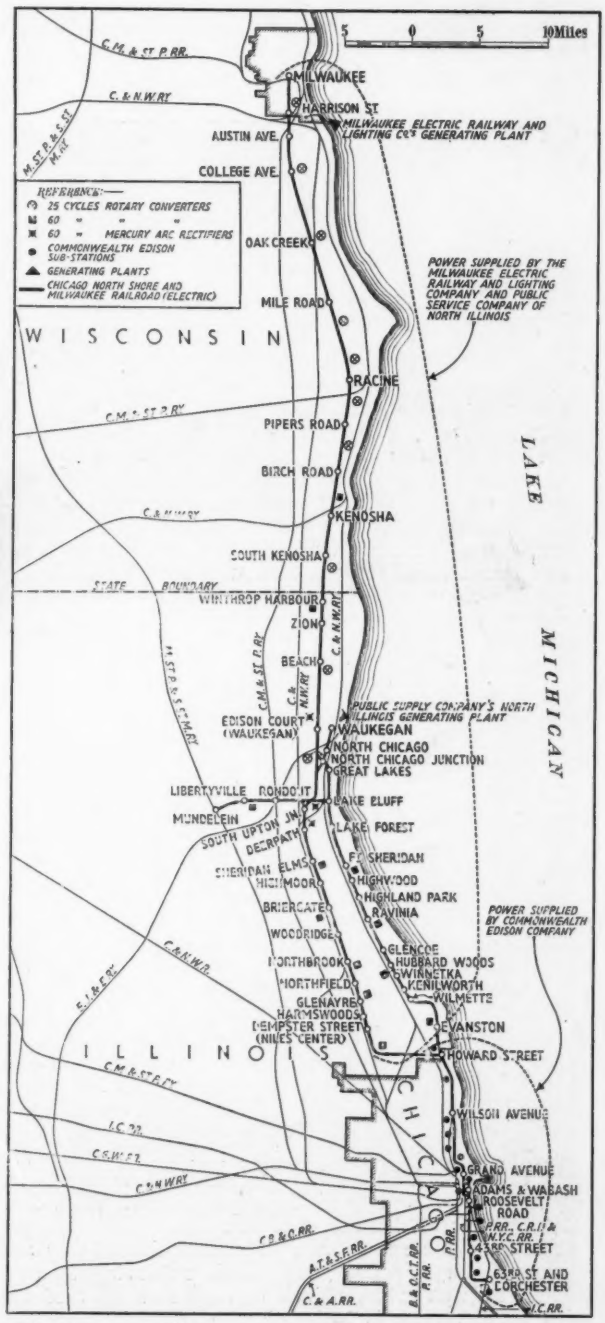
Kenosha, Wis., and by 1906 the line was completed to Racine. Construction between Racine and Milwaukee was completed and operation into the latter city began in October, 1908, the railway then linking Evanston and Milwaukee.

The line then was mainly double tracked, except for a stretch of 11 miles south of Milwaukee. Bridges were of permanent construction, of concrete and steel, as far north as Racine, while those between Racine and Milwaukee were constructed as temporary timber trestle structures. The transmission and distribution system was carried on 35 to 40-ft. cedar poles, spaced 100 ft. apart with simple suspension. Substations were constructed at intervals of about ten miles and the rotary converter equipment was supplemented in each case by storage batteries.

The financial panic of 1907 had brought the company into receivership, and in 1916 the road was reorganised as the Chicago, North Shore & Milwaukee Railroad. An extensive programme of rehabilitation was undertaken. New concrete and steel bridges were constructed; the remainder of the line between Milwaukee and Racine was double-tracked, except for a section of less than a mile where very heavy and costly construction would be required because of the necessity of rebuilding four bridges. This short stretch is protected by block signals. The alignment and level of the track were improved by rock ballasting, and the power facilities were improved by the construction of new substations as well as increasing the capacity of the old.

In September, 1919, service was extended into Chicago from Evanston, with trains operating over the tracks of the Chicago elevated railroads. The Chicago-Milwaukee schedule then required 2 hr. 35 min.

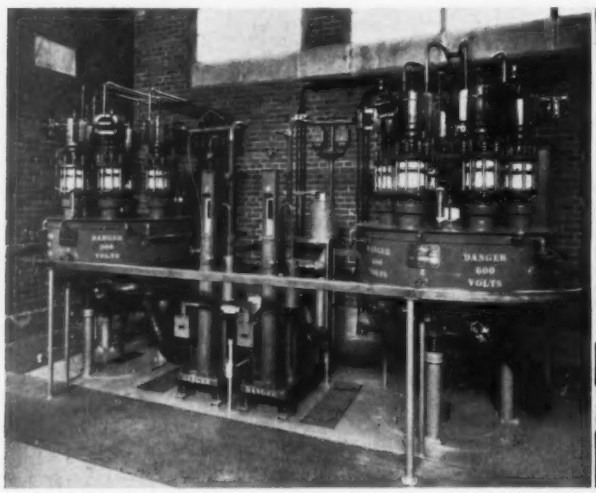
In 1920 a new terminal station was opened in Milwaukee and subsequently attractive passenger stations were constructed in other cities. Less-than-carload freight stations



Map of Chicago, North Shore & Milwaukee Railroad showing its relation to neighbouring lines

were built in the principal towns served. In 1925 a large proportion of the main-line track between Waukegan and Racine was relayed with 100 lb. rails, and in 1926 automatic block signals were installed on 11 miles of double track extending from the Wisconsin State Line southward.

To make provision for faster service between Chicago and the Wisconsin towns, a new line was undertaken in 1924. It was extended westward from Howard Street, the northern city limits of Chicago, for a distance of about five miles, thence turning north through open country to avoid high speed operation through the suburban towns. This new line, known as the Skokie Valley Route, was opened for use in 1926, and is of standard double track interurban construction. Development of the lines since 1916 is evidenced by the fact that then it comprised 162·3 single track miles and to-day it is a double-track system embracing 271·5 miles of single track, nearly one-half of which is of 100 lb. rail construction, and 42·6 miles of sidings and spur tracks.



Interior of automatic substation, showing 1,000 *kW. rectifiers and auxiliaries*

Exterior of substation, showing incoming extra-high-tension apparatus

Present Operation

The entire line is double-tracked except for one short section, but little more than one-half mile in length. It traverses a distance of 87·9 miles from its principal Chicago station at Adams Street and Wabash Avenue to the Milwaukee Terminal station; twelve miles of this distance is operated over the tracks of the Chicago Rapid Transit Company to Howard Street, the city limits. A few trains go to and depart from 61st Street on the south side of Chicago, 7 miles south of the loop. The through Chicago-Milwaukee trains operate from Howard Street over a privately-owned right of way to the city limits of Milwaukee, using the city streets from there to the Milwaukee terminal station, a distance of 2·7 miles. The suburban service to the cities and towns between Chicago and Waukegan operates over tracks laid on city streets for short distances in a few suburban towns, thence on private right-of-way to the city of Waukegan where it again uses city streets for a distance of three miles.

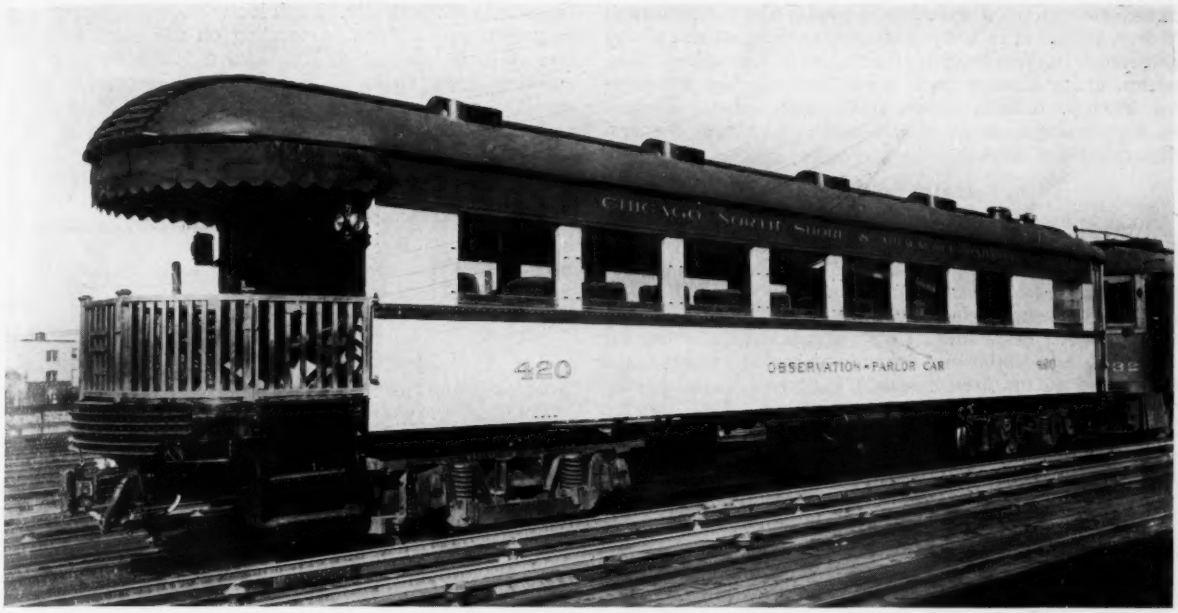
The main-line operations over private right-of-way are performed on standard gauge track employing 80 and 100 lb. rails on creosoted oak ties. The track used for high speed service is ballasted with crushed stone, but much of the city street operation is over rails laid on steel ties which are completely embedded in concrete, making a monolithic construction. There are five steel bridges over the lines of other railroads, fourteen steel bridges and eight timber trestles over streets and streams, one steel viaduct in Milwaukee, and one steel trestle and bridge spanning the Chicago Sanitary District Canal, a highway, and a railroad.

The equipment is operated by 600-volt direct current delivered through 26 substations, 21 of which are automatically operated. In 1916 there were only eight substations, all of which were manually operated. The average distance between substations (all of which are of 1,500 kW. capacity) now is 4·3 miles, except on the most recently constructed portion, the Skokie Valley route, where they are only 3·5 miles apart. Power is delivered to the equipment on the lines of the Chicago Rapid Transit Company by third rail, but overhead lines are used on the North Shore property. The Skokie Valley Line is equipped with a long-span catenary system suspended from steel bridge structures. The primary spans of this distribution system are 250 ft. in length and the primary and secondary messengers are copper cables which serve as feeders of the distribution system. Directly below these messengers is suspended the usual 4-0 trolley wire as a conductor. This section of the line is immediately adjacent to two e.h.t. transmission systems of 132 kV.

Passenger Equipment

The passenger equipment consists of 182 cars for interurban service, including nine dining cars, five observation-parlour cars, and seven combination passenger and baggage cars; 134 of the passenger coaches are of steel construction, including 121 motor cars and 13 trailers. Seven of the dining cars and all of the parlour-observation cars are trailers. The steel cars used in passenger service are equipped with Westinghouse Electric Company's type HLF multiple-unit double-end control and Westinghouse Traction Brake Company's type AMU double-end air equipment. The motor cars are equipped with four 140 h.p. nose-suspended Westinghouse 557 A-5 and R-5 motors, driving through normal spur and helical gears.

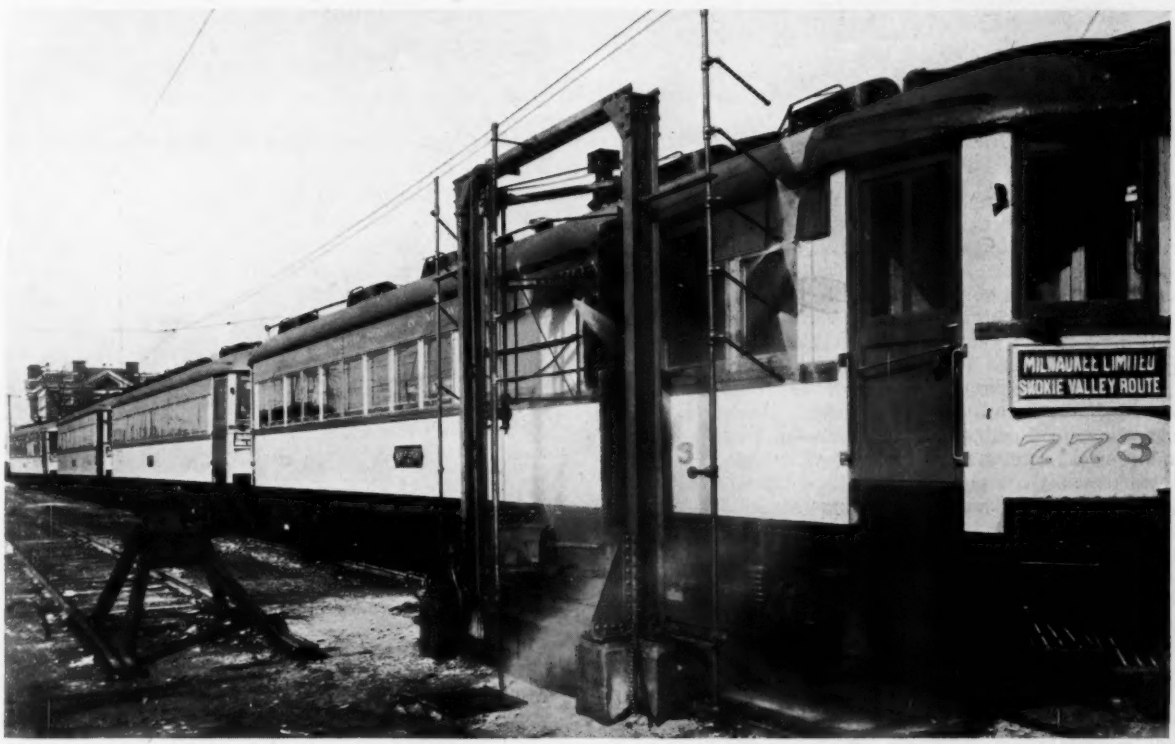
Forty-six of the passenger coaches have individual chair type seats, and the balance have Walkover seats; the seating capacity is 52 passengers per car. The five parlour-observation cars have at one end a closed vestibule



An observation-parlour car used on the fast trains between Chicago and Milwaukee

and at the other a full observation platform with brass railing and extended roof protection. The 25 newest coaches were built in 1930 by the Standard Steel Car Company and the next older group consists of 15 built in 1928 by the Pullman Car & Manufacturing Company. All passenger equipment built since 1923 has a double heating system consisting of hot-water coal-burning heaters and fully automatic thermostatically-controlled electric heat. The 40 newest cars in interurban service are unusual in that they have separate toilets for men and women. Health Department certified drinking water is available in ice cooled tanks.

The wooden interurban coaches, now used only in tripper service and during periods of unusually heavy



One of the four-car express electric trains of the Chicago, North Shore & Milwaukee Railroad passing through the car washing machine

traffic, are equipped with four General Electric motors of 75 h.p. each. The forty-four cars used in street railway operations in Waukegan, Illinois, and Milwaukee, Wisconsin, are in three groups; some have two General Electric 25 h.p. motors, others have four General Electric 50 h.p. motors, while others again have four General Electric 35 h.p. motors.

Freight Equipment

Because its trains operate into Chicago over the tracks of the elevated railroads, which have sharp curves and close station clearances, and in Milwaukee on the city streets, the railroad cannot transport heavy freight equipment into either terminal city. Its less-than-carload business is moved in 47 merchandise despatch cars, every car having its own double-end control equipment and air brake apparatus; 40 of these cars are motorised, some having two 140 h.p. motors, others four. These cars have the same motor and control equipment as used on the passenger coaches.

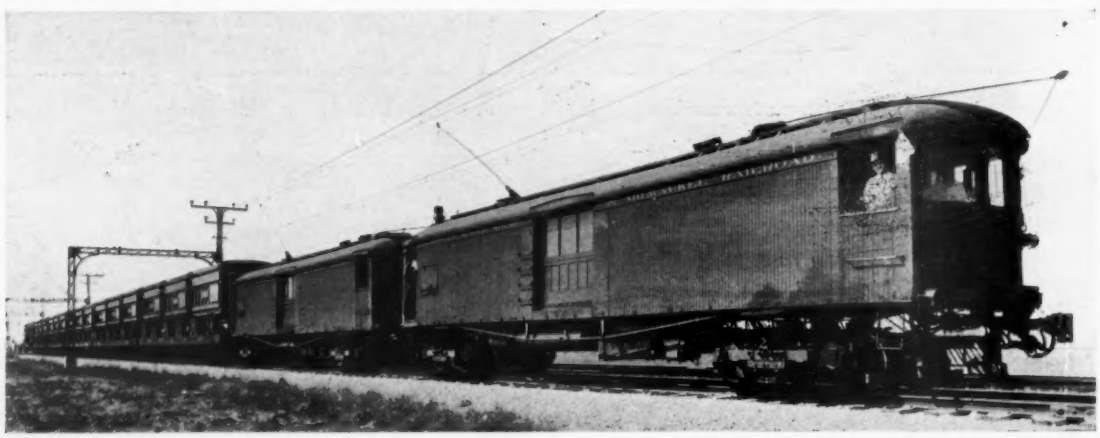
There are seven electric locomotives, all built by the General Electric Company. Two are 40-ton, three are 50-ton and two are 70-ton capacity. The 40-ton locomotives were built in 1907, the 50-ton between 1918 and 1923 and the 70-ton in 1928; all have steeple-type cabs and the two newest, in addition, have auxiliary end cabs for the purpose of housing storage batteries.

Other line cars, snow sweepers, and miscellaneous work and freight cars make a total of 204 freight cars. The locomotive and merchandise despatch cars, as well as all passenger equipment, have two Baldwin swivel equalised trucks with 36-in. rolled steel wheels. The locomotives are all equipped with General Electric double-end control; four of them have Westinghouse No. 14 EL double-end air equipment, while the others have General Electric type L-2 double-end air apparatus.

The two newest locomotives are combination storage battery-trolley locomotives, so designed that the battery is automatically charged whenever power is supplied by the trolley. The battery is charged by means of a motor-generator feed, making possible more uniform charging than could be obtained from a fluctuating trolley line voltage. Each of these locomotives has a total weight of 140,000 lb. and can traverse curves having a radius of 50 ft. The battery is a 192-cell MVA-41 Exide-Ironclad, and is capable of delivering 260 kWh. in one charge. The motor-generator feed is rated at 25 kW.; when the battery is about 15 per cent. discharged, the charging feed is started automatically. Each locomotive is equipped with four 200 h.p. motors. Operating on the batteries alone, one of these locomotives can haul a 1,000-ton train at a speed of from 10 to 12 m.p.h. Each locomotive has a one-hour rating in tractive effort of 22,000 lb. at 14 m.p.h. and a continuous rating of 17,000 lb. at 15 m.p.h. when operating from a 600-volt trolley. Because of the limitations of its freight handling ability, the North Shore Line has devised a ferry truck plan for the movement of entire trailers loaded with merchandise on specially designed flat cars. It has also equipped flat cars for the loading of ordinary commercial trucks and the transportation of truck and its contents by rail.

Passenger Service

The North Shore Line operates 224 regularly scheduled passenger trains daily; 36 of these are fast limited trains running between Chicago and Milwaukee while the balance furnish frequent service to the suburban towns north of Chicago. From 6.00 a.m. to 10.00 p.m. there is an hourly service of fast trains making the 90-mile journey (the exact distance depending upon the Chicago station used) in 112 to 127 min. inclusive of five to seventeen intermediate stops. Some of the point-to-point bookings are probably without rival, and the timings of the hourly trains between leaving the Milwaukee suburban area and entering that of Chicago make the whole service the fastest of its kind in the world. Typical timings are shown in the accompanying table.



Train of ferry truck containers hauled by electric locomotive on the Chicago, North Shore & Milwaukee Railroad

REPRESENTATIVE TRAINS BETWEEN MILWAUKEE AND CHICAGO

Distance							
miles			a.m.	a.m.	p.m.	p.m.
0·00	Milwaukee	dep.	6.00	8.00	3.00	8.00
0·97	National Avenue	,,	6.04	8.04	3.04	8.04
2·80	Harrison	,,	6.12	8.12	3.12	8.12
22·88	Racine	,,	6.32	8.32	3.32	8.32
32·89	Kenosha	,,	6.42	8.41	3.41	8.41
41·59	Zion	,,	6.52	—	—	—
47·93	Waukegan (Edison Court)	,,	6.59	8.54	3.54	8.54
50·89	N. Chicago Junction ...	,,	7.05	—	—	—
71·92	Niles Centre	,,	7.25	—	—	—
76·86	Howard Street	,,	7.32	9.25	4.25	9.25
88·90	Roosevelt Road	arr.	8.01	9.52	4.52	9.52

Although the overall times from Milwaukee to Chicago (Roosevelt Road) average only 47·5 m.p.h., the trains make six intermediate stops in the last 12 miles from Howard Street. After clearing the Milwaukee suburban

zone at Harrison the timings thence into the Chicago area at Howard Street are remarkable. The standard timings are 73 min. for the 74·06 miles with three intermediate stops (60·9 m.p.h.) and 80 min. with six intermediate stops (56 m.p.h.). Over the 15·04 miles from Kenosha to Waukegan (Edison Court) the normal start-to-start timing is 13 min., equivalent to 69·4 m.p.h., and over the 10·01 miles from Racine to Kenosha start-to-start, 9 min., or 66·75 m.p.h. Moreover, it is over the shorter distances that the highest speeds are found, for the 28·93 miles start-to-start from Edison Court to Howard Street take 31 min., or 56·2 m.p.h., but the stop at Howard Street is probably longer than at the other stations. One of the most astonishing performances of the day is that of the 9.00 p.m. out of Milwaukee, which takes only 33 min. from leaving N. Chicago Junction to clearing Howard Street, 25·97 miles, inclusive of 11 stops. Similar services and speeds are in operation in the reverse direction.

Of the 72,214 passenger trains operated over the entire system in 1933, 95·32 per cent. reached their destination on scheduled time. The railroad now has permanent possession of the Electric Traction Speed Trophy awarded for the fastest consistently sustained electric interurban schedule in America. This award was won by the railroad in five of the last seven years. The period covered by the last award represented a schedule speed record of 51·27 m.p.h. including fourteen regular scheduled stops, and a speed of 70·42 m.p.h. not including stops. The effective maintenance of equipment is indicated by the fact that in 1932 an average of 140,807 car miles were operated per equipment failure. In May of that year a total of 659,875 car miles were operated with only one delay due to equipment failure.

Grade Crossing Protection

The North Shore Line operates through a populous territory and consequently crosses a large number of well-travelled highways. In 1908 only one of 155 grade crossings had any mechanical protective device, a bell and light signal. The railroad now crosses 185 highways at grade. Of this number 87 are protected by crossing gates; 42 crossings are equipped with automatic warning devices, such as wig-wag signals and flasher lights. Two crossings are protected by flagmen and 44 rural crossings, lightly travelled, are provided with standard railroad crossing signs. Of the 87 gate protected crossings, 48 are supplied with automatic gates operated by track circuits and actuated by the presence in the circuits of approaching trains. During the past four years the railroad has vigorously pushed a programme of automatic gate installations, with the result that 17 more crossings are now gate protected than was the case at the beginning of 1930. The number of automatic gate installations has increased from eight in 1930 to 48 at the present time.

Related Operations

In addition to its interurban transportation of passengers and freight, the railroad furnished street railway and motor bus service in the cities of Waukegan and North Chicago, which have a combined population of 45,000. It also maintains a limited street railway operation over certain streets in the city of Milwaukee. A motor bus service is operated through certain towns immediately south of the Wisconsin State Line into Waukegan, as a feeder to the rail service 44 railcars and 24 buses, operated by a force of 60 men, are used in these related operations. The Railroad maintains its own Commissary Department to furnish food and supplies to its dining cars, and operates restaurants serving food and light refreshments in its stations in all principal towns and cities. About 100 people are employed in these services. The company's railway operating revenues are derived from its various services in approximately the following proportions: 77 per cent. from the interurban transportation of passengers, 6 per cent. from the operation of city railway and motor bus lines, 8 per cent. from merchandise despatch or less than carload, and 9 per cent. from carload freight business.

Cost of Operation per Car Mile on the Electrified Chicago, North Shore & Milwaukee Railroad

	1932	1933
	$	$
General expenses	0·1357	0·1137
Wages of train crews	0·0568	0·0514
Other conducting transportation costs	0·1138	0·0945
Maintenance of overhead equipment	0·0057	0·0056
Maintenance of substations	0·0037	0·0040
Maintenance of rolling stock	0·0516	0·0470
Maintenance of way and structures	0·0375	0·0334
Cost of electric power	0·0498	0·0496
Total	$0·4546	$0·3992
Car miles operated	8,641,334·03	8,805,640·12

The figures dealing with the cost of operation need some explanatory comment. The item "General Expenses" appears to be rather high in comparison with some other electrified railways, unless it is recognised that the entire operation in the city of Chicago is over the tracks of the Chicago Rapid Transit Company. As the classification of accounts for electric railways prescribed by the Interstate Commerce Commission is used, the cost of the Chicago operation appears under "General Expenses." Thus, substantial charges which would otherwise appear under cost of power and the maintenance accounts are included in "General Expenses." Similarly, heavy rental of stations expense increases the item "Other Conducting Transportation Costs" to an apparently very high proportion. Unless the figures are read in the light of these and other considerations peculiar to the particular property, they would be very misleading.

Electrical Development in the U.S.S.R.

On January 10, Mr. Allan Monkhouse read before the Institution of Electrical Engineers an interesting paper on Electrical Developments in the U.S.S.R., in which mention was made of the proposals of the Soviet authorities for extensive railway electrification, a subject which received detailed attention in the issue of this Supplement for December 15, 1933. Mr. Monkhouse said that it was intended to electrify some 3,800 km. of railway line before 1937, but the map which he reproduced showed that the ultimate intention was to convert a considerably greater mileage, including the Trans-Siberian line as far east as Chita (including both of the two routes between Moscow and Omsk), and the Moscow-Leningrad, Moscow-Crimea, and Turksib lines. The type of current and voltage for use on long-distance main-lines has not yet been settled, but various types are to be tried out on the experimental section now being laid down near Moscow.

Norwegian Electrification Proposal. — Investigations into the possibility of electrifying the main line of the Norwegian State Railways from Oslo to Bergen have shown the cost of conversion to be well over £2,000,000, which sum includes new electric rolling stock, but not the removal of adjacent telegraph lines, which would be necessary in view of the standard Norwegian single-phase traction current.

AOSTA - PRE ST. DIDIER ELECTRIC RAILWAY

This short Italian line lying in the shadow of Mont Blanc carries a heavy mineral and tourist traffic

THE railway line from Aosta to Pré St. Didier in Piedmont forms part of a transport system built by the Società Metallurgica Cogne mainly for the transport of anthracite. In view of the considerable tourist traffic in the whole valley of Aosta, one of the most picturesque mountain districts of Italy, this particular line was built as a standard gauge railway. It has all the characteristics of a typical mountain railway and necessitated a large number of constructional works such as tunnels (of which there are 18 in all), retaining and protection walls, and consolidation works.

A view from one of the eighteen tunnels

The line is single track and has a length of 31·4 km. (19½ miles). The average gradient is 1 in 73 and the maximum 1 in 33, this latter remaining practically constant on the second section of the line from Arvier to Pré St. Didier. Besides the two terminal stations there are six intermediate stations at Sarre, Villanova Baltea, Arvier, Avise, La Salle, and Valdigna respectively. Practically the whole line runs in curves as sharp as 7½ chains radius, and the tangents are generally not longer than 200 m. (660 ft.).

The line is electrified on the d.c. 3,000-volt system with overhead contact lines. Although a lower tension would have been sufficient, preference was given to high tension in order to keep the line uniform with the State Railways' system, and also in view of future developments. (The line was purchased in 1931 by the State Railways.) Current is supplied by the substation at Avisa about midway along the line. The electric equipment consists of two mercury arc rectifiers of 1,000 kW. each of which are inserted on the a.c. side in the 20 kV. transmission net of the Cogne Company.

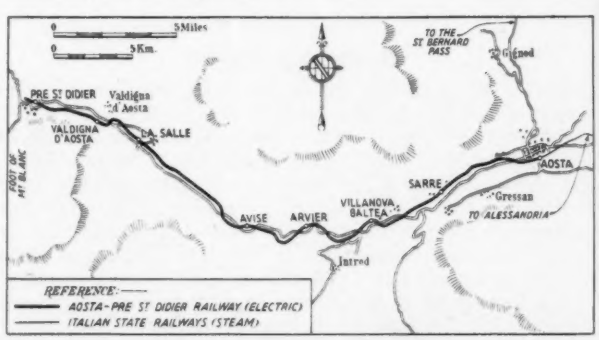
The electric locomotives were built by the Officine di Savigliano to suit the particular requirements of the line, where speed is *a priori* restricted by the many curves and gradients, as well as by the short distances between the stations. The electrical equipment was built to the designs of the Metropolitan-Vickers Electrical Co. Ltd.

The locomotives are of the Bo-Bo type and have the following characteristics:—

Length over buffers	11·150 m. (36 ft. 7 in.).
,, of body	10·000 m. (32 ft. 9⅜ in.).
Distance between bogie centres	5·600 m. (18 ft. 4½ in.).
Bogie wheelbase	2·400 m. (7 ft. 10½ in.).
Total hourly capacity	720 h.p.
Tractive effort at rim of wheels	6,000 kg. (13,228 lb.).
Speed	31 km.p.h. (19¼ m.p.h.).
Total weight	41·7 tonnes (41·0 tons).
Weight of electrical part	19·25 tonnes (18·95 tons).

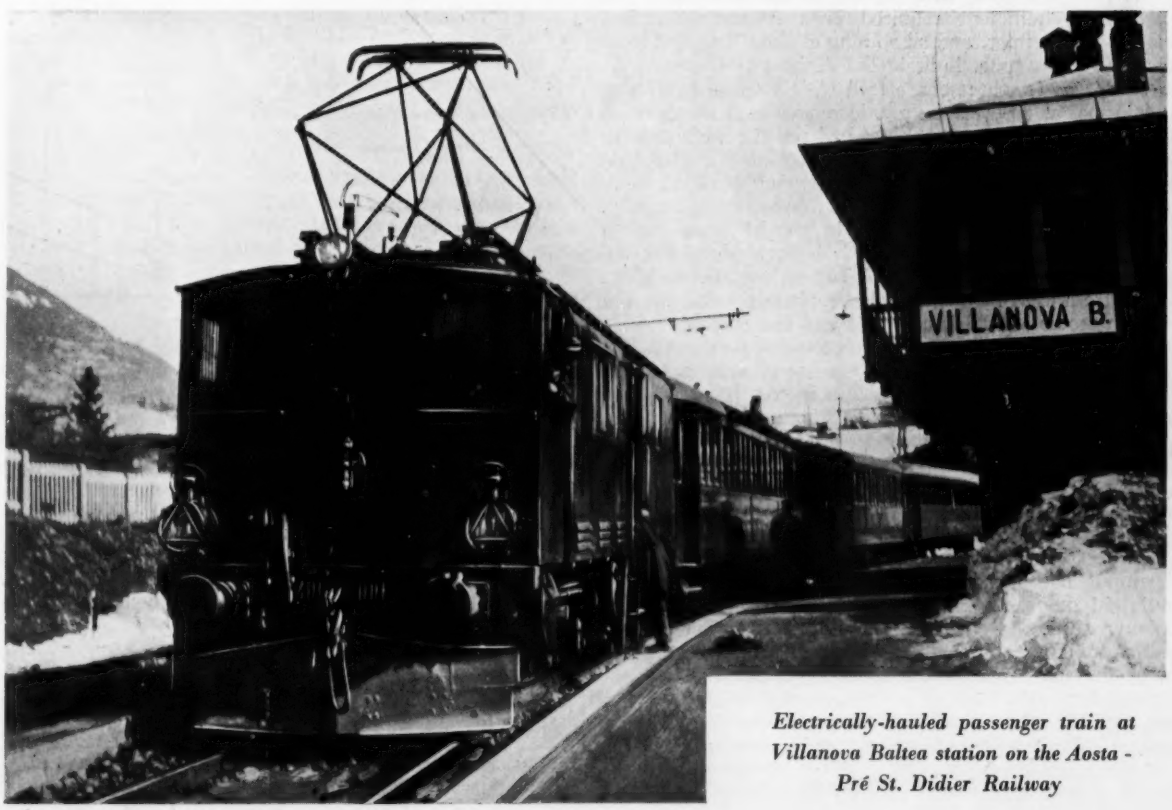
The electrical equipment is placed only in one part of the locomotive, and the space between this compartment and the second driving cab is used for luggage. The entire body and framework is of electrically - welded steel. The bogies also are electrically welded, and the spring brackets, brake supports, and other mechanical parts are integral with the frame structure. Each bogie carries two self - ventilated nose-suspended motors with an hourly rating of 180 h.p. at 620 r.p.m. and 96 amp. The auxiliary machinery consists of a motor-generator set; an automatic voltage regulator, a motor - driven compressor, battery, electro-pneumatic controller, and an electro-magnetic and hand controller for the auxiliary services.

The 3,000-volt motor of the motor-generator group is of the bipolar type and is mounted on the same shaft as the dynamo which has a continuous capacity of 110 amp. and a tension varying from 90 to 110 volts. It feeds a motor compressor through an automatic controller. The compressor is of the horizontal two-cylinder type and has a capacity of 1,000 litres per min. The electro-pneumatic control gear is of the multiple-unit type and includes a group of electro-pneumatic contactors, an electro-pneumatic reverser, a master controller with separate handles for power and reversing, and an auxiliary relay connected with the overload relay. The pantograph is of the double-pan type and is electro-pneumatically controlled. As a rule, the passenger trains are made up of two or three cars, but goods trains up to 300 tons are hauled up the steepest grades.



Map showing electrified Aosta - Pré St. Didier section of the Italian State Railways

Goods train hauled by 3,000-volt d.c. double-bogie electric locomotive on the Aosta - Pré St. Didier Railway, a standard-gauge line which runs up the Baltea valley from Aosta to the foot of Mont Blanc



Electrically-hauled passenger train at Villanova Baltea station on the Aosta - Pré St. Didier Railway

RECTIFIER LOCOMOTIVES

A general consideration of the use of mercury arc converters in locomotives is supplemented by a detailed examination of the characteristics of single-phase/direct current rectifier equipment

THE performance of grid-controlled mercury-vapour converters of the various types required for the rectification of a.c., the conversion of d.c. to a.c., and the changing of phase and/or frequency, opens new possibilities in electric locomotives with motors using current in a form different from that in which it is delivered at the contact wire or rail. A number of different combinations of supplied current and motor current are possible, those of greatest practical importance being shown by the following table:—

	Supply to Contact Line or Rail	Locomotive Motors	Converting Equipment Required
(*a*)	1 ph. or 3 ph. a.c.	D.C.	Rectifier.
(*b*)	1 ph. or 3 ph. a.c.	3 ph. or 1 ph. a.c.	Phase and frequency converter.
(*c*)	D.C.	1 ph. or 3 ph. a.c.	Inverted rectifier.

From a general consideration of the characteristics, it is evident that group (*a*) is the most important class because it permits supply to be taken from the national a.c. network, it takes advantage of the convenience and economy of single-phase distribution, and it enables d.c. traction motors to be employed. Also, as shown by the following general comparisons, it requires less auxiliary apparatus than other systems.

General Comparisons

(*a*) *Rectifier Locomotives.*—With single-phase supply to the contact wire and d.c. motors in the locomotive the conversion equipment required is a mercury rectifier, rectifier transformer, and smoothing choke. The first locomotives of this type, built to the designs of Dr. Ing. W. Reichel* was for three-phase feed with a variable tapping transformer as used on the a.c. locomotives of the German State Railway. These machines had not the advantage of grid control which was applied in the later single-phase d.c. rectifier locomotives with the following advantages:—(1) Performance independent of frequency of supply. (2) About 15 per cent. saving in weight when fed at 50 cycles per sec., compared with a single-phase locomotive for $16\frac{2}{3}$ cycles per sec. (3) The railway network can be fed from the general 50-cycle supply network. (4) The traction motor control is complete and loss-free.

(*b*) *Phase and Frequency Converter Locomotives.*—The contact wire or wires carry single-phase or polyphase a.c., as the case may be. The traction motors have no commutators; their general construction is that of synchronous motors, but the utilisation of material is less satisfactory. In addition to the mercury-vapour converter tank, transformers are required for the supply and for the converted output. The latter transformation can be effected by the stator winding of the traction motors.

Owing to the fact that a transformer must be used on the input side, the motor voltage can be such that commutation offers no difficulty and the elimination of the commutator by the mercury converter is therefore no particular advantage. For individual driving of the axles, each commutatorless motor needs a special converter, an arrangement which is at a disadvantage compared with the parallel operation of d.c. motors in the rectifier locomotive. With polyphase supply and a converter feeding synchronous or asynchronous motors,* neither the simplicity of the equipment nor the power factor conditions can compete with those of the rectifier locomotive. Phase-converter locomotives can be controlled by frequency regulation down to zero frequency (d.c.), but they are heavier than rectifier locomotives and ordinary single-phase $16\frac{2}{3}$-cycle locomotives.

(*c*) *Inverted Rectifier Locomotives.*—In this case, the contact line is fed with d.c. and the locomotive uses induction motors. The equipment comprises an inverted mercury rectifier, transformer, oscillating condenser, and smoothing choke. The frequency of the alternating current is variable within wide limits but not down to zero, and the voltage is only controllable down to a definite limit. In general, the controllability is inferior to that of a rectifier locomotive and the weight is higher owing to the heavy battery of condensers required.

Rectifier Locomotive Circuits

Whether or not regenerative braking is employed, the single-phase d.c. rectifier locomotive offers important advantages in point of simplicity and saving of weight. Also, the electrical conditions in the internal and external circuits, and particularly the phase displacement of the primary current, can be made eminently satisfactory. Methods employed to attain these results and the important advantages derived from the use of a star-point anode are explained in the following paragraphs and illustrated by the accompanying drawings.† It is claimed that in this form the rectifier locomotive is a thoroughly practical proposition.

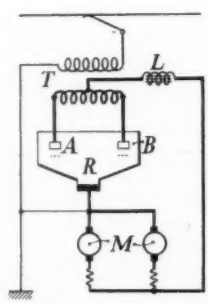


Fig. 1—Diagrammatic representation of single-phase d.c. rectifier connections for locomotive operation

Corresponding to the single-phase feed of the Reichsbahn, the 1 ph./d.c. type of locomotive is chosen. In its simplest form, the circuit is as shown diagrammatically in Fig. 1. The rectifier R is fed by the transformer T and the motors M, in series with the smoothing choke L, receive a d.c. voltage variable between zero and a maximum. With natural commutation, *i.e.*, firing of anodes not delayed by grid control, the d.c. voltage is as shown by the heavy curve in Fig. 2(a); while with delayed commutation the conditions are as at Fig. 2(b) for half the maximum d.c. volts, the curves V_a and V_b representing the voltages on anodes A and B relative to the neutral point. In the case represented by Fig. 2(b), the direct current flow is maintained by the choke L from D to F until the anode B

* *Z.V.d.I.*, 1925, p. 52.

* M. Schenkel and J. v. Issendorff. *Siemens Zeit.*, Vol. 11, p. 145.
† M. Schenkel and J. v. Issendorff. *Siemens Zeit.*, Vol. 13, p. 289.

fires at D, but there is a back-e.m.f. to be overcome (horizontal shaded area). The direction of energy flow reverses at E resulting in wattless power on the a.c. side and demand on the storage effect of the smoothing choke on the d.c. side. These disadvantages are greatly reduced by the Siemens-Schuckertwerke star-point anode and by the use of multi-stage anodes resulting in voltage regulation and improved power factor without any mechanical

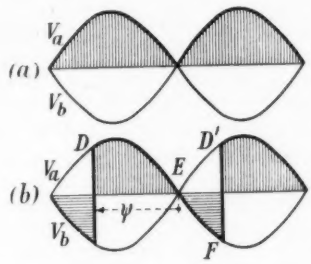


Fig. 2—Voltage curves for single-phase rectifier as in Fig. 1 with: (a) natural commutation; (b) delayed commutation

switching of the various anode leads, *i.e.*, by grid control alone.

As shown in Figs. 4(b)(d), the star-point anode is connected directly to the neutral point of the transformer and is *not* grid-controlled. It carries current when the neutral is temporarily positive with regard to the mercury cathode owing to the effect of the smoothing choke. Referring to Fig. 3, the anode A is fired at D and carries current until the point E is reached. Beyond this point the potential of A becomes negative relative to the neutral; the current flow therefore transfers to the star-point anode and flows through it until, at G, the anode B fires. The anode A carries no current during the period E-G, and the smoothing choke is relieved of supplying energy corresponding to the area E F G. The phase angle ψ of the ignition point D relative to the point E is smaller in Fig. 3 than in Fig. 2(b) for the same d.c. volts. The relations between the percentage d.c. volts and the angle ψ with and without a star-point anode, are shown in Figs. 4(a)(b).

The effect of the star-point anode can be supplemented by subdividing the transformer winding and taking each tapping to a grid-controlled anode. Control is then effected by using first the anodes A_1, B_1 giving the lowest voltage, the anodes A_2, B_2 being meanwhile blocked. On reaching the maximum voltage thus obtainable, the higher-voltage

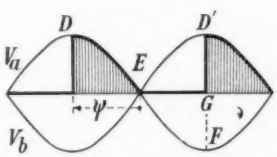


Fig. 3—Voltage curve for single-phase rectifier with star-point anodes

anodes are brought into action with delayed firing, and ultimately maximum voltage is reached with natural commutation on all anodes. Compared with the ordinary 1-ph. locomotives, this system avoids all contacts or tapping switches in the secondary circuit, and fewer tappings are required.

Operating Characteristics

The control characteristics for the multiple-anode arrangement are obtained by combining those for Figs. 4(a)(b). The d.c. voltage rises abruptly from zero directly ψ exceeds 90 deg. in Fig. 4(a), but with a star-point anode the rise is continuous for all values of ψ from 0 to 180 deg. When using intermediate anodes for the lower range of d.c. voltage, Figs. 4(c)(d), the voltage curve would flatten near 180 deg. if the outer anodes were not brought into action till the intermediate ones reached their maximum. To avoid this, the higher-voltage group of anodes is brought into action at 120 deg. as shown dotted in the characteristics Figs. 4(c)(d), thus giving a steady rate of voltage change up to near the maximum, which now occurs at ψ = 300 deg.

Fig. 5 shows the voltage curves of the inner and outer pairs of anodes and the effective portions of each for values of ψ from 30 to 300 deg., using four grid-controlled

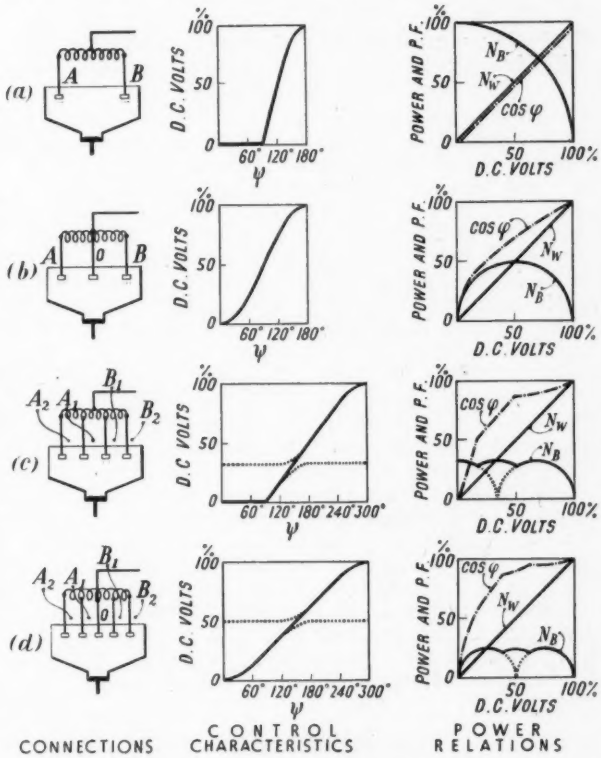


Fig. 4—Voltage control, power and power factor conditions for various arrangements of single-phase rectifiers

anodes and a star-point anode as in Fig. 4(d). At ψ = 150 deg, both sets of anodes are fired 120 electrical degrees apart, a condition which is easily fulfilled by a commutator with segments suitably interconnected. The commutator is driven synchronously with the a.c. supply; the brush rockers are shifted by the driver's controller; and the grid voltages are derived from an auxiliary battery. Accurate control is thus obtained independent of disturbances in line voltage by short circuits or atmospheric discharges. Purely electrical control of grid action is also possible.

Primary Current Conditions

The a.c. line current to a grid-controlled rectifier lags to a greater extent the greater the delay in firing of the anodes, *i.e.*, the lower the d.c. volts. The voltage drop resulting from the wattless current may be serious; *e.g.*, under unfavourable circumstances the available voltage at starting may be half the open-circuit value.

The star-point anode affords relief in this respect as will

be seen from the power relation diagram in Fig. 4, where the effective power N_W, wattless power N_B, and p.f. cos ϕ are plotted against the percentage d.c. volts, for constant d.c. current in each case (starting with constant torque).

The quantities N_W, N_B and the d.c. voltage are referred to their respective maxima, as reached with natural commutation (maximum ψ) and the highest voltage pair of

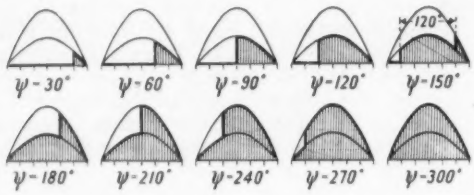


Fig. 5—Diagram showing form of voltage curves corresponding to Fig. 4 (d) throughout the range of regulation, using two sets of anodes and a star-point anode

anodes. Then, in each case, N_W is represented by a diagonal straight line; and N_B is represented by circular arcs and becomes smaller as the number of anodes is increased. In Fig. 4(d) the mean wattless power N_B is about one-quarter of the value for Fig. 4(a). Due to overlapping of the anode controls N_B never falls to zero as dotted in Figs. 4(c)(d). The values of cos ϕ correspond to N_W and N_B, and the improvement at (d) compared with (a) Fig. 4 is obvious. In case *d*, the p.f. is 0·9 or higher at and beyond half the full d.c. voltage.

As regards the distortion of the primary current by the rectifier, experience on the Berlin Stadt u. Ringbahnen shows that no trouble is experienced from the higher harmonics resulting from plain rectifiers, without grid control. Tests on connection b, Fig. 4, show that no supplementary distortion of the primary current is produced by grid control. The distortion is, in fact, rather less with reduced than with full d.c. voltage. Moreover, the harmonics arising from several rectifier locomotives in the same section tend to neutralise each other, unless all the controls happen to be in the same setting at a given moment. Under practical conditions the primary a.c. wave form is better when supplying a number of rectifier locomotives than when supplying plain rectifiers of the same power.

D.C. Circuit

The most advantageous method of driving is considered to be by a series-wound d.c. motor on each axle of the locomotive. The inductance of the field winding renders a smoothing choke unnecessary if a six-phase rectifier is used, but in the present case of single-ph. supply, the waviness* of the d.c. voltage is much greater than with a 6-ph. rectifier, say 47 per cent. compared with 4 per cent., and rising much higher for low d.c. voltages in the case represented by Fig. 4(a). With the circuit as in Fig. 4(d), the waviness of the d.c. voltage is less than 30 per cent. for heavy starting currents. The use of a smoothing choke cannot, however, be eliminated when working from a 50-cycle, single-phase system, and the magnitude of the choke depends on the waviness permissible from the standpoint of commutation; 10 per cent. waviness has no detrimental effects in ordinary series motors, and from 30 to 40 per cent. is permissible in specially built machines.

The d.c. series motors used should be provided with compensating windings and interpoles, and should be designed for as high voltage as practicable in order to secure maximum rectifier efficiency, and a saving in the weight of cooling equipment. The arrangement shown in Fig. 4(d) does not secure maximum utilisation of all anodes but, on the other hand, it effects a saving in transformer copper because part of the heavy starting current flows via the star-point anode.

Regenerative Braking

Regenerative braking to standstill is possible with a rectifier locomotive, but, in addition to the requisite changes in the grid control circuit, the polarity of the motor circuit must be reversed, the direction of current flow being determined by the rectifier. A convenient arrangement consists of using an auxiliary rectifier for separate excitation of the motors, which then operate as generators with shunt or compound characteristics. The main rectifier operates as a mains-excited inverter, converting the generated d.c. to single-phase a.c. and feeding it back to the lines. For regenerative braking, the star-point anode must be provided with a grid which is blocked during certain stages of braking. The outer, inner and star-point anodes are used successively as the train speed decreases to zero. The line voltage is not increased by regenerative braking, but reduced owing to the wattless, magnetising power which is still taken from the a.c. side.

The cost of the special equipment required for regenerative braking on rectifier locomotives is only justified where the number and nature of gradients result in substantial recovery of energy. Mechanical braking must, in any case, be provided as a stand-by, because regenerative braking is impossible if the a.c. supply voltage fails for any reason.

* By waviness is meant the ratio of the effective value of the superimposed a.c. voltage to the mean d.c. voltage obtained with natural commutation.

THE COMMERCIAL POLAND.—A supplement on the commerce and industries of Poland has just been issued by *The Financial Times*, which, although lacking a good transport map, contains up-to-date information on the communication systems, and a short summary of industrial electrification during the past ten years. It is stated that over the Warsaw suburban lines now being electrified by the English Electric Co. Ltd. and the Metropolitan-Vickers Electrical Co. Ltd., the distance of 2,289,700 km. worked yearly by steam trains will be increased to 3,377,700 km. when conversion is complete, and this increase of 44 per cent. in the mileage will be accompanied by cuts of up to 30 per cent. in the timings.

LONDON TRANSPORT RECTIFIERS.—Two B.T.H. rectifiers of 2,000 kW. rating at 630 volts have been installed during the past year in a new substation of the London Passenger Transport Board. Three further rectifiers of the same rating have been completed and will be shortly installed in the Leicester Square substation of the same undertaking, and will make this the largest rectifier substation, when overloads are taken into account, in the country.

P.O.-MIDI LOCOMOTIVE ORDERS.—Contracts about to be completed for electric traction material by the P.O.-Midi system include 15 motor coaches, and four high-speed electric locomotives of 4,000 h.p. The first of the four locomotives is to be built by the Soc. de Matériel de Traction Electrique; the second by the Soc. Alsthom; and the remaining two by the Soc. Oerlikon in conjunction with the Commentry-Châtillon group. Double-bogie locomotives of 1,400-1,600 h.p. are also being delivered.